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Assessment of cod in Division 4X in 2004

Évaluation de la morue de la division 4X en 2004

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ABSTRACT

The TAC from 2000-2004 has been 6,000 t annually and landings dropped to the lowest recorded level in 2003 at 5,600 t. Despite the record low landings, survey biomass indices have not increased. Recruitment indices in both surveys have shown improvement for 1998-2001 year classes over other recent year classes. The 2002 year class, however, appears weak. Rebuilding was expected to be supported by the incoming 1998 and 1999 cohorts but their abundance declined more rapidly than expected and an increase in biomass did not materialize. Prospects for rebuilding are now dependent only on the incoming 2001 year class and it is unlikely that any sustained increase in biomass will be achieved at a TAC of 6,000 t.

RÉSUMÉ

Au cours des années 2000 à 2004, le total autorisé des captures (TAC) de morue de 4X a été fixé à 6 000 t par année, et les débarquements ont chuté pour atteindre la valeur record de 5 600 t en 2003. Malgré les faibles débarquements records, les relevés révèlent que les indices de biomasse n'ont pas augmenté. Les indices de recrutement fondés sur les résultats des deux relevés montrent une amélioration chez les classes d'âge de 1998 à 2001 par rapport à d'autres classes d'âge récentes. La classe d'âge de 2002 semble cependant faible. Le rétablissement des stocks devait être appuyé par les cohortes de 1998 et de 1999, mais l'abondance de celles ci a diminué plus rapidement que prévu et la biomasse n'a pas augmenté. Les perspectives de rétablissement dépendent maintenant uniquement de la classe d'âge de 2001, et il est improbable qu'une hausse soutenue de la biomasse puisse se produire si le TAC demeure fixé à 6 000 t.

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INTRODUCTION

Recent assessments of 4X cod have been problematic. The 1999 assessment presented two possible analyses as equally consistent with the data; one estimated a spawning stock biomass of 19,000 t, and the other a biomass of 30,000 t. The higher estimate included high biomass estimates at older ages, but also indicated that older fish did not contribute much to the fishery. The projected $F_{0.1}$ yields were 4,100 t and 5,600 t respectively. In 2000, a single VPA was accepted at RAP. This also had relatively high estimates of biomass at older ages, but indicated they would make very little contribution to the fishery. The $F_{0.1}$ projection for yield in 2002 was about 4,200 t from an estimated spawning stock biomass of 40,000 t.

In the 2002 assessment, this VPA formulation displayed a strong retrospective pattern. Analyses of survey data also showed high total mortality estimates, while comparisons of reported landings and survey catch gave low relative fishing mortality estimates. Since, unlike areas further east, the seal population was not thought to be high in 4X and fish condition showed no decline, it was concluded that increased natural mortality was unlikely to be responsible for this discrepancy. It was suggested that much of this discrepancy could have been caused by unreported landings and discarding in the fishery in 2000 and 2001. In 2003, no VPA formulation was accepted.

Differences in survey trends among regions in 4X were felt to be contributing to problems in the analysis, and further attempts at analytical assessment were forestalled, pending completion of tagging studies and conclusions on how to partition landings to appropriate biological stock components. This work is underway, and is expected to yield results by the spring of 2005. In the interim, survey and fishery data are examined to determine if population biomass has increased to an extent which could permit an increase in TAC, following 5 years at the low TAC of 6,000 t. Available information from landings data and observers are also examined to determine if there is evidence of discarding or misreporting in the fishery.

DISCRIPTION OF THE FISHERY

Landings of cod from NAFO Subdivision 4X (including the Canadian portion of 5Y; Fig. 1) increased through the 1960s as foreign and domestic otter trawler fleets became active in the fishery (Table 1; Fig. 2). Landings declined in 1970, primarily due to restrictions on haddock fishing. Landings peaked again in the early 1980s, due to increases in inshore catches. In 1981 handline landings exceeded 5,000 t, and landings in 4Xo exceeded 12,000 t (Table 2). Recent landings are, in part, a reflection of the TAC which declined from 26,000 t in 1992 to 6,000 t in 2000. The quota has been held at 6,000 t for 5 years as part of a rebuilding strategy for 4X cod. As of November 11th, 2004, 3,652 t of cod has been landed in the current quota year.

The fishery takes place year round, peaking in June and July (Table 3). Landings from the winter declined after 1992, with many fishing sectors treating cod as a by-catch as they pursued other species. Since 2000, the quota year has run from April 1st –March 31st. With this change in fishing year, and the increase in haddock quotas relative to cod, the winter haddock fishery has increased, and winter landings of cod have also increased.

In 2001 and 2002, the cod fishery was reported to have improved in most areas, aside from the coastal hook and line fisheries. The distribution of landings was similar to recent years, with a high proportion of landings in the Bay of Fundy (4Xqrs5Y), and Georges and Crowell basins (4Xp)(Fig. 3). This is a general pattern in the groundfish fishery and reflects shifts in the distribution of abundance for a number of species.

Most groups reported no difficulty in catching their quota despite the fact that many were directing their effort primarily for haddock. Fishermen maintained that cod quota was the most restrictive in the mixed species groundfish fishery, and that they needed to try and avoid cod to remain within their quota while pursuing haddock. This is reflected in annual quota reports, where a larger proportion of the cod quota was caught compared to other species in the fixed gear and small dragger fisheries (Table 4). Fishing in inshore areas of 4Xo, however, was poor for both cod and haddock, with fishermen having to travel further offshore. Landings of cod from 4Xo declined below 1,000 t for the first time in 2002 (Table 2).

In 2003 and in 2004, fishing was reported to have been poor in most coastal areas. Many fixed gear fishers delayed their activity in 2003, reportedly due to the prevalence of dogfish early in the summer and low water temperatures; they were then not able to land their full quota in the fall before switching to lobster fishing. In 2004 poor fishing for both cod and haddock inshore, coupled with low prices for groundfish and high bait costs, led many hook and line fishers to curtail their fishing activity. The number of vessels active in the fishery in 4X continued to decline, particularly for handline, which has all but disappeared (Table 5a), and reported fishing effort for groundfish has dropped in 2004 for hook and line vessels (Table 5b). Landings by the fixed gear fleet to November are lower than for the same period in 2003 and it appears unlikely that they will catch their quota (Table 4).

The small dragger fleet in 2004 appears likely to catch its cod quota, as the proportion caught by early November is higher than in 2003 (Table 4). Gillnet landings are also higher in 2004 than in 2003 (Table 1), as this fleet has not reported any difficulty catching cod.

There were numerous reports of cod being discarded or landed unreported in 2000 and 2001 to avoid exceeding the quota. This was thought to have decreased in 2002. There have been few reports from industry of discarding since 2002, and some have maintained that it was never a serious problem. Given the low proportion of the quota landed so far in 2004, it seems unlikely that discarding is an issue this year.

The majority of landings are subject to dockside monitoring. Monitored trips accounted for 85% of reported cod landings in 2003; thus, it seems unlikely that the potential for misreporting of landings in unmonitored trips could be resulting in a significant underestimate of landings in the fishery as a whole.

Discrepancies in species composition between trips carrying an observer and unobserved trips may be indicative of potential discarding or misreporting of landings. The level of observer coverage in 4X has generally been below 1% (Table 6), too low for any meaningful comparisons. Observer coverage increased in 2004, but much higher coverage,

stratified to account for heterogeneity in the fishery, would be required to make useful comparisons of observed and unobserved trips. Experience with the 5Z groundfish fishery, which is less heterogeneous, suggests that 10% observer coverage may not always be sufficient for detecting potential discarding.

Catch-at-Age

Fishery Samples

Catch-at-age was derived following standard protocols for this stock (Clark et al., 2002). Length frequency samples were aggregated to give catch at length by gear, area and quarter-year, while age-length keys were produced for area and quarter (Table 7a and b).

Landings

The size composition of the catch peaks at a somewhat lower length on the Shelf than in the Bay of Fundy, reflecting differences in growth between these areas (Fig.4). In both areas the peak is consistent with length at age 3, the 2000 year class.

In both 2001 and 2002 the 1998 year class dominated the landings of 4X cod, and the contributions from ages 7+ were very low (Table 8). In 2003, landings were dominated by the 1998 and 1999 year classes; the age range in the fishery showed some expansion, and was similar to the long term average age composition (Fig. 5). In 2004, landings have been dominated by the 2001 year class (Table 8). Ages 7+ were a small part of the fishery in the first half of 2004.

In the 2003 assessment, it was reported that weights-at-age from the commercial fishery appeared to have increased in recent years (Clark and Hinze, 2003; Table 9a). When samples from the deeper water of the Fundian Channel and Gulf of Maine in 4Xp are grouped with the Bay of Fundy, rather than with Browns Bank and the Scotian Shelf, this trend is less pronounced (Table 9b). The increase in landings from these areas, where faster growing cod are found, led to an apparent increase for Scotian Shelf cod.

ABUNDANCE INDICES

The annual DFO Research Vessel (RV) survey, employing a stratified random survey design with about 70 stations sampled annually, and the joint DFO/industry small dragger survey (ITQ), employing a fixed station design with 184 stations, are used for abundance indices for this resource (Clark et al., 2002). The DFO Research vessel survey has been conducted annually since 1970; however, due to uncertainties regarding the appropriate conversion factors to apply in relation to changes in vessel and net, only data after 1982 are used as indices (Clark et al., 2002).

Due to repair work which was ongoing to the CCGS Alfred Needler during the July survey period, the CCGS Teleost was used in its place. The Teleost used a Western IIa trawl which had some slight modifications to its foot gear. These changes in vessel and gear

may have some impact on catchability, although this is not expected to be large. The results for the 2004 survey may not, therefore, be directly comparable to those from other years. Comparative surveys are planned for 2005 following which conversion factors between the two vessels will be calculated.

There were few good catches of cod in the RV survey in 2004 (Fig. 6). The number of sets completed in the Bay of Fundy was lower than in recent years (21 in 2004 versus 37 in 2003 and 29 in 2002); however, sampling remained adequate, with at least 2 stations occupied in each stratum. As in 2003, few cod were caught in the southern and eastern parts of the Shelf in 4X.

The distribution of catches in the ITQ survey in 2003 differed from other years (Fig. 7). There were few good catches in the Bay of Fundy or on German Bank, where the biggest catches are usually made. There were many sets where catch for that location was at or below the five year median for the survey series in the Bay of Fundy (Fig. 8). Most sets where catches were above the median were located around Browns Bank and on the Scotian Shelf.

In the Bay of Fundy, the research vessel (RV) survey biomass index has been variable without any persistent trend since 1983 (Fig. 9). The index in 2002 and 2003 was above the 1983-2003 median but in 2004 was the second lowest. The 2004 index may not be directly comparable to previous years because the survey was conducted by the *Teleost* and conversion factors between it and the *Needler* are not available. The ITQ survey biomass index has shown little variation since 1996, except for the anomalously high value in 2001(Fig. 9). It also declined substantially to its lowest level in 2004.

On the Scotian Shelf, the RV survey biomass index shows a declining trend since 1996 and remained at the lowest level in 2003 and 2004(Fig. 10). The ITQ survey biomass index shows little interannual variability since 1996 and the 2004 biomass was above the median (Fig. 10).

ITQ survey catches-at-length were below the median for most commercial lengths in the Bay of Fundy, and above the median only from 16-28 cm (Fig. 11). The modal length at 55 cm was consistent with what was seen in the fishery, but the low numbers of fish over 65 cm differed from the commercial fishery. The length frequency from the Shelf was similar to the median for most lengths, and above the median from 40-55 cm. This is consistent with the commercial catches for the Shelf.

RV survey catches in 2003 were at or above the median at most lengths in the Bay of Fundy, but in 2004 catches were above the median only from 46-59 cm (Fig. 12). The paucity of fish outside this length range differs from both the ITQ survey and the commercial fishery. RV survey catches were below the median on the Shelf for most lengths. The absence of a mode for the Scotian Shelf size composition is not consistent with the size composition from the ITQ survey or the fishery, and is unlikely to be representative of the population.

Some of the difference in the survey catches is due to differences in catchability-at-length by the gear employed. The ITQ survey uses rock hopper foot gear which leaves little space for escape below the footrope, and has proportionately higher catches of cod less than 50 cm. The differences between the two surveys may also reflect the high variability in survey catches, as is seen in inter-annual variability in the longer RV series, or differences in the completeness of geographic coverage of the 4X area.

RV survey indices in 2004 are low for most ages, except for continued indication of above average abundance for the 2001 year class in the Bay of Fundy (Table 10, Fig. 13). The age range also remains constricted, with no cod caught above age 6 in the Bay of Fundy, or above age 8 on the Scotian Shelf.

ITQ survey catches-at-age in 2004 were high in the Bay of Fundy for age 1, at the median for the series for ages 3 and 6, and low for all other ages. On the Scotian Shelf, catches were among the highest in the series (1996-2004) for ages 3-6 (Table 11, Fig. 14). Indices of abundance from the ITQ survey have consistently indicated that the 1999-2001 year classes are stronger on the Scotian Shelf than any since the1994 year class. There has been little change in catches for ages 7+ in this survey since its inception, and catches in 2004 were near the median for these ages.

Recruitment indices (ages 1-3) in both surveys have shown improvement for 1998-2001 year classes over the previous five year classes; however, initial indications from both surveys are that the 2002 year class is weak for both the Bay of Fundy and the Scotian Shelf.

Lengths-at-age from the RV survey show some variability over time, particularly on the Scotian Shelf, but show no consistent trend across ages (Figure 15). Condition (Fulton's K) has been very stable in the Bay of Fundy (Fig.16). Cod from the Scotian Shelf have shown greater variability in condition. Condition dropped to a low in 1985, but has been fairly stable at average levels recently.

The proportion of RV survey sets where cod are caught (design weighted area occupied) in the Bay of Fundy has varied considerably without trend since 1983 (Fig. 17). On the Scotian Shelf, area occupied has varied considerably, but declined annually from 1999 to 2003 and remained near the lowest in the series in 2004.

For the ITQ survey, there has been a gradual decline in the proportion of sets where cod are caught and a sharp decline in the proportion of fixed stations where the catch in a year was above the median for that location for the Bay of Fundy (Fig. 18). Both the proportion of sets where cod were caught and the proportion > median are low for the Scotian Shelf, but the decline is less severe and it remains within the range seen in other years.

Total mortality (Z), as calculated from the RV survey has high inter-annual variability (Fig. 19). The absence of any apparent trend is not consistent with the reductions in nominal landings and fishing effort; however, the high Z's in recent years in the Bay of Fundy do not suggest there has been any decline in mortality levels in response to the low TAC in recent years.

SOURCES OF UNCERTAINTY

Cod in the 4X/5Y management area have been considered a stock complex comprised of a number of spawning components. Difficulty in separating landings has precluded analyses of discreet components. The similarities in past abundance trends for components had alleviated concerns about treatment as a single management unit. A divergence in population trends among these components would be inconsistent with model assumptions. Efforts to delineate components based on tagging and biological data are underway.

Reports of current and historical discarding and under-reporting indicate that these vary among years. Prior to the mid-1980s misreporting could also have included over-reporting of landings from other species or areas as 4X cod. This uncertainty can potentially be alleviated in future years with additional effort in monitoring, and by following the delineation of stock components. Inter-annual variability in natural mortality must also be considered. An increase in natural mortality would be consistent with the continued high total mortality despite reductions in TAC.

The lack of an analytical assessment compromises the ability to assess the status of the stock, and puts heavy reliance on the survey indices. The survey results are highly variable from year-to-year, and their interpretation is subject for concern. The *Teleost* was used for the RV survey in 2004. Also, bottom temperatures were 2-3° C below average at the time of the summer survey. These lower temperatures delayed fishing activity in 2004.

OUTLOOK

Condition and length-at-age are both about average with little recent variation. This differs from cod further east, and indicates that growth rates are not a concern in 4X. Area occupied has declined in the surveys. The number of sets in which no cod are caught has increased, but there are not broad areas in which cod are consistently not caught. This would seem to reflect the overall low abundance rather than a range reduction.

The 2002 year class appears weak in both surveys. This will enter the fishery in the Bay of Fundy in 2005, and appears unlikely to make a major contribution to landings. Recruitment is strong for the 2001 year class. In 2004 this year class appears dominant in both surveys and the commercial fishery.

While the 2001 year class continues to look strong in both surveys, only the ITQ survey on the Shelf continues to indicate that abundance at older ages may be above even recent averages. Older ages were well represented in the fishery in 2003, but in the first half of 2004 their contribution was much reduced. The paucity of older fish in the fishery, along with the high Z's from the survey, indicates total mortality has remained high.

Survey biomass indices show that overall biomass has not increased since 1999 when the quota was reduced to 6,000 t to promote rebuilding, and may have declined; therefore, an increase in quota is not supported.

Rebuilding was expected to be supported by the incoming 1998 and 1999 year classes, but their abundance declined more rapidly than expected and an increase in biomass did not materialize. Prospects for rebuilding are now dependent only on the incoming 2001 year class. It is unlikely that any sustained increase in biomass will be achieved at a TAC of 6,000 t.

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Table 1. Canadian landings of cod in 4X (and Canadian portion of 5Y) by gear and tonnage class.

	Otter Trawl					Gill Net		Long Line			Hand		
Year	0&1	2	3	4	5+	0&1	2&3	0&1	2	3+	Line	Misc.	Total
1953	27	87	53	3								12,884	13,054
1954	34	113	17	7						321		13,914	14,406
1955	51	121	6	10						271		12,973	13,432
1956	118	104	42	4					376	414		13,791	14,489
1957	240	173	143						1,777	370		10,876	13,579
1958	240	314	127	52				1	1,197	591		8,552	11,074
1959	552	565	234						1,182	608		9,679	12,866
1960	578	426	229	10		1		2,740	1,007	497	4,802	1,833	12,123
1961	505	735	390	12		520		2,269	1,502	597	4,661	1,209	12,400
1962	565	1,007	971	410		645		2,883	1,337	456	4,571	1,702	14,547
1963	258	877	1,159	1,414		748		2,839	1,021	398	5,417	1,660	15,791
1964	457	1,484	1,610	4,163		750		2,672	1,151	677	5,403	4,442	22,809
1965	466	1,758	2,320	7,857		765		3,502	885	564		6,132	24,249
1966	284	2,023	3,064	7,222	72	851		3,733	513	702		5,700	24,164
1967	6,026	2,358	3,377	7,281	1,483	1,847		3,027	373	940	5,205	1,598	33,515
1968	253	2,245	3,684	7,596	3,111	1,856	0	3,482	479	806	5,766	1,509	30,787
1969	207	1,385	2,448	4,298	3,721	926	0	3,554	513	681	4,446	1,533	23,712
1970	158	1,151	1,529	1,960	1,259	653	0	4,171	515	768	3,444	2,410	18,018
1971	81	1,097	1,611	1,799	1,220	546	4	5,472	691	1,575	4,421	1,783	20,300
1972	121	1,235	1,635	2,246	1,371	1,187	0	6,119	668	1,174	3,128	1,646	20,530
1973	100	1,214	1,232	1,350	553	669	0	7,407	1,048	1,641	3,672	1,105	19,991
1974	128	1,433	1,310	575	577	1,851	0	6,834	1,400	1,096	3,247	490	18,941
1975	129	2,666	1,298	460	601	1,482	27	6,013	1,600	781	2,526	2,001	19,584
1976	82	1,025	1,263	436	896	2,403	167	4,828	1,067	1,479	2,867	525	17,038
1977	298	1,972	2,909	527	1,065	2,052	79	6,151	1,831	907	2,943	1,254	21,988
1978	615	1,805	2,573	745	1,731	2,562	96	6,904	2,216	1,149	2,059	1,264	23,719
1979	663	1,749	2,744	1,139	1,405	3,527	116	7,517	2,051	862	4,140	2,770	28,683
1980	1,322	2,769	4,284	1,042	2,037	2,683	61	8,356	2,360	898	4,198	1,267	31,277
1981	1,165	3,086	2,989	416	1,131	2,871	114	10,302	2,555	1,235	5,174	483	31,521
1982	879	3,159	4,493	563	2,217	3,154	214	9,120	3,465	1,087	4,299	484	33,134
1983	638	4,735	6,306	518	1,118	2,180	235	5,747	2,757	883	3,750	604	29,471
1984	964	4,198	5,904	302	1,513	1,248	220	3,916	2,825	980	3,005	453	25,528
1985	523	3,954	5,562	90	1,185	1,837	161	2,617	1,740	635	2,755	440	21,499
1986	573	3,663	5,123	224	974	1,453	196	2,479	1,918	576	2,490	371	20,040
1987	312	2,645	3,504	531	929	1,968	241	3,075	2,175	499	2,670	456	19,005
1988	454	3,966	3,542	160	467	903	444	3,528	3,149	672	3,081	171	20,537
1989	409	3,933	4,184	67	713	1,254	475	2,915	2,167	623	2,937	208	19,885
1990	505	3,668	3,577	268	170	1,933	692	4,201	2,967	849	4,871	203	23,904
1991	355	4,598	5,805	298	751	2,225	619	4,712	3,679	842	3,737	128	27,749
1992	238	4,494	5,711	143	726	1,811	586	4,455	3,574	719	3,517	106	26,080
1993	176	2,778	3,598	68	241	1,387	523	2,768	1,693	310	2,439	45	16,026
1994	132	2,022	2,343	138	82	993	421	2,837	1,412	231	2,367	67	13,045
1995	100	1,387	1,619	112	75	470	507	1,632	959	182	1,706	18	8,767
1996	92	1,552	2,314	157	103	611	442	1,774	1,306	201	1,914	106	10,572
1997	79	2,094	2,430	136	35	694	471	2,013	1,255	231	1,794	6	11,238
1998	96	1,407	1,892	166	22	429	376	1,663	997	244	879	0	8,169
1999	85	776	1,254	63	11	494	404	1,480	762	119	743	0	6,190
2000	113	851	1,268	78	9	358	356	1,420	533	106	662	1	5,755
2001	120	975	1,292	29	9	383	390	1,532	423	72	409	0	5,707
2002	181	874	1,482	0	51	520	535	1,487	395	55	286	2	5,869
2003	299	710	1,518	8	5	599	433	1,496	348	60	145	1	5,620
2004*	250	602	1,212			574	582	942	159	20	116	0	4,457

* 2004 landings for Jan. 1 – Nov 5.

Table 2. Nominal catch of 4X cod by unit area.

Year	4Xm	4Xn	4Xo	4Xp	4Xq	4Xr	4Xs	4Xu	5Y	Shelf	Fundy	Foreign	Total
1956	1,981	1,043	5,909		756	2,648	817			8,933	4,221	1,663	13154*
1957	1,929	1,447	6,369		934	2,041	616			9,745	3,591	1,083	14,419
1958	1,480	1,130	5,056		651	1,859	774			7,666	3,284	1,110	12,060
1959	2,212	937	5,302		1,123	2,339	1,340			8,451	4,802	862	14,115
1960	1,654	963	5,164		885	2,373	828			7,781	4,086	1,605	13,472
1961	1,630	1,279	5,275	24	892	2,449	905			8,208	4,246	1,272	13,726
1962	1,520	1,031	6,250	651	768	2,946	1,327			9,452	5,041	1,280	15,773
1963	1,862	829	6,861	1,443	767	2,419	1,579			10,995	4,765	1,995	17,755
1964	2,194	2,178	7,471	3,334	1,093	3,572	1,317			15,177	5,982	4,688	25,847
1965	1,665	2,088	6,526	7,733	962	4,091	1,215			18,012	6,268	2,693	26,973
1966	2,201	1,521	5,444	7,254	1,099	4,607	2,032			16,420	7,738	6,746	30,904
1967	2,384	1,400	7,120	8,041	1,276	5,425	2,051			18,945	8,752	4,651	32,348
1968	3,251	2,059	8,159	9,341	1,327	4,785	1,849	4	65	22,810	8,030	4,776	35,616
1969	2,413	2,923	7,355	5,523	947	3,686	1,120	59	60	18,214	5,872	8,704	32,790
1970	2,851	1,300	6,966	2,310	1,077	2,621	847	23	26	13,427	4,594	4,308	22,329
1971	2,750	1,728	9,029	2,157	1,395	2,355	754	13	119	15,664	4,636	3,197	23,497
1972	3,124	1,585	8,908	1,421	1,938	2,818	977	7	52	15,038	5,792	1,902	22,732
1973	2,130	1,478	10,180	1,228	1,742	2,186	802	179	67	15,016	4,976	2,222	22,214
1974	2,243	1,122	9,369	955	1,526	2,839	768	1	120	13,689	5,254	2,166	21,109
1975	81	1,374	967	1,033	864	2,867	133	12,180	86	3,455	16,130	1,598	21,183
1976	1,973	1,408	8,267	743	1,061	2,034	601	40	16	12,391	3,752	519	16,662
1977	184	1,706	1,229	1,487	907	2,686	122	13,562	105	4,606	17,382	378	22,366
1978	2,812	2,864	8,522	3,591	2,286	2,246	676	341	382	17,789	5,931	301	24,021
1979	6,565	2,750	10,495	1,748	2,325	2,550	1,646	229	379	21,558	7,129	78	28,765
1980	5,205	3,325	9,899	1,561	3,571	4,684	2,278	47	166	20,023	10,712	541	31,276
1981	4,767	2,114	12,097	1,830	2,413	5,072	2,031	419	599	21,051	10,290	179	31,520
1982	5,255	2,922	10,451	2,079	3,715	4,571	2,009	538	1,349	20,956	11,933	245	33,134
1983	3,437	1,690	8,537	2,497	3,160	3,787	1,674	1,826	2,543	16,891	12,258	320	29,469
1984	2,255	2,251	6,192	1,655	2,244	2,959	1,414	3,583	2,698	14,110	11,141	277	25,528
1985	3,006	1,199	5,438	1,026	1,999	2,301	1,511	3,608	1,364	12,236	9,216	47	21,499
1986	2,914	1,762	4,670	544	1,754	1,802	1,500	4,469	557	11,748	8,224	68	20,040
1987	2,676	1,611	4,777	1,131	1,240	858	1,207	5,116	360	12,783	6,179	29	18,991
1988	1,502	1,086	5,458	1,271	1,124	850	1,103	7,990	142	14,814	5,711	11	20,536
1989	1,370	1,019	5,506	2,820	1,360	1,112	915	5,267	478	13,855	5,994	38	19,887
1990	1,846	764	7,915	1,746	2,238	1,721	1,722	5,404	326	15,551	8,119	222	23,892
1991	2,552	1,584	8,963	2,440	2,763	4,243	2,560	2,246	307	17,275	10,383	91	27,749
1992	1,523	1,818	10,347	1,455	2,919	3,352	1,503	2,876	278	17,556	8,515	9	26,080
1993	1,364	1,646	4,845	1,436	1,959	2,428	1,399	760	189	9,924	6,102	0	16,026
1994	828	561	4,414	1,128	1,662	1,883	892	1,540	137	8,321	4,724	0	13,045
1995	293	696	1,737	1,586	1,306	1,032	510	1,528	79	5,349	3,418	0	8,767
1996	466	813	2,787	1,484	1,608	1,659	930	654	171	6,055	4,517	0	10,572
1997	453	837	2,213	1,327	1,793	2,240	1,070	1,303	183	5,943	5,479	0	11,422
1998	477	907	1,634	1,796	983	1,284	606	331	151	5,064	3,105	0	8,169
1999	397	584	1,548	1,288	956	778	408	111	121	3,817	2,373	0	6,190
2000	291	395	1,433	1,198	1,071	680	413	151	124	3,317	2,439	0	5,756
2001	257	535	1,049	1,395	985	814	441	125	106	3,236	2,471	0	5,707
2002	230	461	873	1,491	1,152	924	458	125	155	3,055	2,814	0	5,869
2003	185	419	690	1,276	719	1,094	690	275	273	2,570	3,051	0	5,622
2004	64	208	333	1,128	905	793	653	263	108	1,733	2,722	0	4,455

* 2004 landings for Jan. 1 – Nov 5.

Table 3.Nominal catch of 4X cod by month for Canadian Maritimes vessels.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Calendar year	Fishing year	TAC
1960	119	428	235	388	1,565	1,329	2,924	1,365	1,703	934	662	417	12,069		
1961	225	298	246	597	964	2,324	2,527	1,397	1,250	1,299	880	416	12,423		
1962	63	108	363	904	1,181	1,984	3,473	1,846	1,988	1,157	926	556	14,549		
1963	309	122	309	577	1,564	2,896	2,570	2,660	1,933	1,714	777	359	15,790		
1964	474	320	832	1,690	1,727	3,182	3,592	2,856	2,417	2,362	899	367	21,067		
1965	392	367	1,229	1,881	2,603	3,724	4,694	2,634	2,708	2,377	927	685	24,221		
1966	911	755	838	2,061	2,034	3,419	4,299	3,323	2,555	2,470	910	588	24,163		
1967	874	823	820	1,462	2,304	5,155	4,210	4,052	3,334	2,962	1,304	513	27,813		
1968	871	1,107	1,406	2,377	3,121	5,009	4,952	4,116	2,742	3,037	1,328	774	30,840		
1969	1,876	1,694	1,071	1,845	2,160	4,176	3,722	2,797	1,943	1,483	827	518	24,112		
1970	805	500	617	970	2,024	2,745	2,775	2,279	1,969	1,874	921	541	18,020		
1971	526	848	584	814	1,725	3,939	3,328	2,483	2,487	1,902	1,110	555	20,301		
1972	862	633	473	744	1,258	3,832	3,982	2871	2038	2663	925	250	20,531		
1973	1,009	925	514	1,056	1,381	3,919	2,937	2,623	2,264	1,544	818	1,001	19,991		
1974	771	397	399	695	1,335	3,583	3,150	2,538	1,968	1,765	877	1,464	18,942		
1975	648	169	394	712	3,223	3,250	3,355	2,647	1,796	1,457	668	1,267	19,586		
1976	363	555	376	581	1,220	2,824	2,869	2,064	1,968	1,399	782	1,140	16,141		
1977	580	940	861	1,580	2,232	3,782	3,366	2,444	1,740	2,048	1,443	973	21,989		
1978	862	2,042	911	1,371	1,987	3,411	3,379	2,920	2,454	1,473	1,085	1,828	23,723		
1979	889	752	1,973	1,400	1,846	4,276	3,638	3,555	3,218	2,233	2,992	1,935	28,707		
1980	706	2,188	1,704	2,485	3,317	5,316	3,433	3,346	2,603	2,876	1,547	1,756	31,277		
1981	1,649	2,451	2,529	1,533	2,881	4,093	3,845	4,067	2,253	3,119	1,728	1,373	31,521		
1982	757	2,390	2,569	1,491	3,415	5,109	4,734	3,258	3,540	2,890	1,244	1,737	33,134		30,000
1983	1,713	1,654	1,648	1,888	2,743	5,713	4,554	2,832	3,183	1,787	1,037	719	29,471		30,000
1984	1,798	2,021	752	817	1,796	3,471	3,688	4,567	2,773	1,668	1,201	976	25,528		30,000
1985	779	1,699	956	1,268	1,974	2,586	3,199	2,650	2,737	1,801	787	1,063	21,499		30,000
1986	904	1,633	1,775	1,450	1,437	1,939	2,739	1,995	2,576	1,714	771	1,107	20,040		20,000
1987	1,208	1,837	1,242	1,059	1,870	2,778	2,663	1,821	1,679	1,403	910	535	19,005		18,000
1988	2,104	1,531	535	939	1,620	2,931	3,104	2,122	2,524	1,441	636	1,050	20,537		16,000
1989	2,150	2,347	1,362	1,707	1,292	3,562	1,830	1,772	1,535	1,278	637	413	19,885		13,000
1990	2,619	2,027	707	778	1,560	3,104	3,751	3,123	2,598	1,689	1,158	790	23,904		22,000
1991	2,023	2,651	993	1,666	2,322	3,167	3,963	2,881	2,967	2,208	1,650	1,258	27,749		26,000
1992	2,088	1,740	1,297	1,502	1,685	3,622	3,366	2,803	2,625	2,353	1,478	1,521	26,080		26,000
1993	657	903	994	996	1,617	2,312	2,834	2,221	1,804	1,048	562	78	16,026		16,000
1994	734	972	547	847	824	1,771	2,246	1,503	1,267	1,154	726	454	13,045		14,000
1995	610	229	317	827	574	1,236	1,771	774	1,071	521	276	561	8,767		9,000
1996	503	331	446	531	819	1,755	1,805	1,317	880	887	679	619	10,572		11,000
1997	98	362	378	806	644	1,440	1,779	1,382	1,548	1,424	710	668	11,239		13,000
1998	285	348	402	313	511	941	1,272	953	1,125	770	520	729	8,169		9,300
1999	186	105	124	330	414	1,047	1,269	856	854	445	324	235	6,190	7,216	7,910
2000	215	255	556	113	368	906	1,104	755	545	507	324	107	5,755	5,834	6,000
2001	361	103	641	315	449	745	870	672	594	470	318	169	5,707	5,908	6,000
2002	376	274	561	624	493	673	837	742	563	358	229	141	5,869	5,798	6,000
2003	296	160	684	289	474	435	559	764	790	562	412	209	5,633	5,472	6,000
2004	117	222	529	449	513	428	626	555	586	418			4,443	3,575	6,000

[a] Prior to 1999 quota year was Jan. 1 – Dec. 31. 1999 quota year was Jan. 1. 1999-Mar. 31. 2000; subsequent to that it is Apr. 1 – Mar. 31.

Table 4. Proportion of groundfish quotas landed in the 4X fishery by gear sector.

2000 Quota Report	cod	haddock	pollock
FIXED < 45'	97%	97%	80%
MOBILE <65' (ITQ)	107%	103%	77%
VESSELS >100'	90%	92%	29%

2001 Quota Report	cod	haddock	pollock
FIXED < 45'	96%	77%	82%
MOBILE <65' (ITQ)	104%	100%	73%
VESSELS >100'	89%	95%	28%

2002 Quota Report	cod	haddock	pollock
FIXED < 45'	96%	94%	72%
MOBILE <65' (ITQ)	102%	99%	91%
VESSELS >100'	65%	80%	61%

2003 Quota Report	cod	haddock	pollock
FIXED < 45'	84%	60%	74%
MOBILE <65' (ITQ)	104%	100%	97%
VESSELS >100'	91%	93%	87%
Aboriginal Fishery	98%	82%	70%

2004 Quota Report	cod	haddock	pollock
FIXED < 45'	64%	26%	74%
MOBILE <65' (ITQ)	60%	43%	68%
VESSELS >100'	30%	17%	62%
Aboriginal Fishery	50%	25%	33%

Landings To November 5th 2004

2003 Quota Report	cod	haddock	pollock
FIXED < 45'	72%	45%	66%
MOBILE <65' (ITQ)	55%	54%	65%
VESSELS >100'	45%	49%	56%
Aboriginal Fishery			

Landings To November 5th 2003

Table 5a. Number of fishing vessels reporting cod landings annually.

Year	Otter trawl	Gill net	Longline	Handline
1996	142	205	528	779
1997	142	197	497	657
1998	129	163	398	422
1999	129	126	357	354
2000	121	101	376	326
2001	112	97	366	201
2002	113	110	381	162
2003	104	102	334	92
2004*	95	92	282	48

*2004 effort to Nov. 5.

Table 5b. Fishing days by gear type.

Year	Gill net	Longline	Handline
1996	4,912	5,210	9,880
1997	6,281	6,179	9,650
1998	4,178	5,352	5,721
1999	3,370	4,156	4,234
2000	2,321	3,794	3,287
2001	2,116	3,895	2,093
2002	2,253	4,232	1,390
2003	2,436	3,911	692
2004*	2,249	2,744	439

*2004 effort to November 5th.

Table 6. Level of observer coverage for cod fishery in 4X.

Year		otter trawl Tonnage	otter trawl proportion	longline Tonnage	longline proportion
2001	observed	45.4	3.80%	11.1	0.74%
	landed	1188		1500	
2002	observed	0.266	0.01%	6.3	0.30%
	landed	1777		1867	
2003	observed	20.2	0.79%	13.1	0.64%
	landed	2540		2055	
2004	observed	77.2	4.20%	12.3	1.12%
	landed	1840		1094	

Table 7a. Construction of catch-at-age for 4X cod in 2003.

Gear	Quarter	Area	a	b	Number of samples	Number Measured	Landings (t)	ALK used
OT	1	Fundy	0.0081	3.0503	6	1,433	452	Q1_Bay
GN					0	Q2_Bay_GN#	6	Q1_Bay
LL					0	Q2_Bay_LL#	11	Q1_Bay
OT	1	4Xmno			2	456	61	Q1_mno
GN					0	Q1_p_GN#	23	Q1_mno
LL					6	1,555	158	Q1_mno
OT	1	4Xp			7	1,537	299	Q1_p
GN					1	83	143	Q1_p
LL					0	Q2_p_LL#	12	Q1_p
OT	2	Fundy	0.0084	3.0410	11	1,930	568	Q2_Bay
GN					2	340	71	Q2_Bay
LL					2	222	115	Q2_Bay
HL					0	Q2_Bay_LL#	35	Q2_Bay
OT	2	4Xmno			0	Q2_mno_LL#	16	Q2_mno
GN					0	Q2_p_GN#	8	Q2_mno
LL					2	479	67	Q2_mno
HL					3	418	25	Q2_mno
OT	2	4Xp			4	853	67	Q2_p
GN					7	909	160	Q2_p
LL					4	272	58	Q2_p
HL					0	Q2_mno_HL#	1	Q2_p
OT	3	Fundy	0.0087	3.0233	7	1,452	407	Q3_Bay
GN					9	1,703	457	Q3_Bay
LL					1	250	104	Q3_Bay
HL					0	Q3_Bay_LL#	35	Q3_Bay
OT	3	4Xmno			0	Q3_Bay_OT#	12	Q3_mno
GN					0	Q3_p_GN#	13	Q3_mno
LL					4	917	689	Q3_mno
HL					0	Q3_mno_LL#	20	Q3_mno
OT	3	4Xp			4	688	89	Q3_p
GN					2	268	22	Q3_p
LL					6	1142	186	Q3_p
HL					0	Q3_p_LL#	3	Q3_p
OT	4	Fundy	0.0063	3.1152	4	908	509	Q4_Bay
GN					0	Q4_Bay_OT#	38	Q4_Bay
LL					2	260	18	Q4_Bay
HL					0	Q4_Bay_LL#	2	Q4_Bay
OT	4	4Xmno			0	Q4_Bay_OT#	4	Q3_mno
GN					0	Q4_p_GN#	13	Q3_mno
LL					2	558	689	Q3_mno
HL					0	Q4_mno_LL#	7	Q3_mno
OT	4	4Xp			0	Q4_Bay_OT#	58	Q3_p
GN					2	310	38	Q3_p
LL					5	788	155	Q3_p

#LF substituted due to absence of commercial sampling for this gear/area/quarter combination

Table 7b. Construction of catch-at-age for 4X cod for 2004.

Gear	Quarter	Area	a	b	Number of samples	Number Measured	Landings (t)	ALK used
OT	1	Fundy	0.0081	3.0503	6	1,595	444928	Q1Q2 Fundy
GN					0	Q2_Bay_GN#	6272	Q1Q2 Fundy
LL					0	Q2_Bay_LL#	5821	Q1Q2 Fundy
OT	1	4Xmno			3	347	38093	Q1Q2 mno
LL					2	415	79483	Q1Q2 mno
OT	1	4Xp			6	1,426	201090	Q1Q2 4Xp
GN					3	887	82979	Q1Q2 4Xp
LL					2	575	9770	Q1Q2 4Xp
OT	2	Fundy	0.0084	3.0410	6	1,590	588113	Q1Q2 Fundy
GN					2	528	141202	Q1Q2 Fundy
LL					1	275	66665	Q1Q2 Fundy
HL					0	Q2_Bay_LL#	3113	Q1Q2 Fundy
OT	2	4Xmno			1	85	24421	Q1Q2 mno
GN					0	Q2_4Xp_GN#	20425	Q1Q2 mno
LL					1	226	48123	Q1Q2 mno
HL					0	Q2_4Xp_LL#	25066	Q1Q2 mno
OT	2	4Xp			1	160	104320	Q1Q2 4Xp
GN					4	1091	327605	Q1Q2 4Xp
LL					0	Q1_4Xp_LL#	34236	Q1Q2 4Xp
HL					0	Q1_4Xp_LL#	1344	Q1Q2 4Xp
OT	3	Fundy	0.0087	3.0233	6	1,411	258901	Q1Q2 Fundy
GN					4	893	352804	Q1Q2 Fundy
LL					1	266	121345	Q1Q2 Fundy
HL					0	Q3_Bay_LL#	27256	Q1Q2 Fundy
OT	3	4Xmno			1	87	5448	Q1Q2 mno
GN					0	Q2_4Xp_GN#	52195	Q1Q2 mno
LL					1	280	199327	Q1Q2 mno
HL					0	Q3_mno_LL#	34187	Q1Q2 mno
OT	3	4Xp			1	115	29045	Q1Q2 4Xp
GN					0	Q2_4Xp_GN#	131321	Q1Q2 4Xp
LL					8	1903	247386	Q1Q2 4Xp
HL					1	38	3351	Q1Q2 4Xp

#LF substituted due to absence of commercial sampling for this gear/area/quarter combination

Table 8. Catch-at-age (numbers in thousands) for cod in Division 4X.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+
1980	0	837	6,054	2,358	1,742	1,135	442	261	91	60	19	17	5	13,021	12,183	6,129
1981	0	818	3,870	4,265	1,644	1,045	587	297	184	75	39	19	19	13,061	12,244	8,373
1982	0	904	2,885	4,414	3,060	912	393	279	146	86	41	25	15	13,160	12,255	9,371
1983	9	1,031	3,689	2,433	2,057	1,205	459	204	120	76	36	10	10	11,330	10,299	6,610
1984	33	917	2,393	3,081	1,930	965	465	176	63	49	29	18	5	10,090	9,173	6,781
1985	0	711	1,674	1,569	2,324	1,284	514	194	71	53	18	7	6	8,425	7,715	6,041
1986	0	251	2,789	1,941	994	1,008	409	200	93	50	23	20	10	7,788	7,537	4,748
1987	0	861	902	2,053	1,087	523	511	236	140	66	33	9	7	6,428	5,567	4,665
1988	0	403	3,517	1,659	1,553	656	178	192	85	53	28	6	9	8,338	7,935	4,418
1989	17	655	2,560	3,656	632	562	163	79	60	19	10	10	2	8,408	7,753	5,193
1990	0	144	2,863	2,805	2,462	497	279	78	40	38	14	15	1	9,235	9,091	6,228
1991	2	391	1,535	5,092	1,777	1,364	215	156	32	16	28	15	6	10,626	10,235	8,700
1992	0	751	3,391	1,878	3,276	878	513	63	50	16	9	4	0	10,828	10,077	6,685
1993	0	881	3,490	2,045	660	672	186	90	14	14	5	0	0	8,056	7,176	3,686
1994	0	475	2,280	2,233	887	195	181	42	18	0	2	0	0	6,314	5,838	3,558
1995	0	135	2,146	1,081	582	130	28	40	11	5	0	0	0	4,158	4,023	1,877
1996	0	50	883	2,594	441	212	29	16	8	2	1	1	0	4,237	4,187	3,304
1997	0	59	1,126	1,556	1,193	199	82	16	2	6	1	3	0	4,243	4,184	3,058
1998	0	234	886	1,021	615	441	54	20	6	2	3	1	1	3,284	3,050	2,164
1999	0	72	834	543	347	264	120	20	7	0	0	1	0	2,210	2,138	1,303
2000	0	218	575	905	247	189	66	27	8	1	1	0	0	2,237	2,019	1,444
2001	0	114	1,187	595	378	75	40	17	12	1	0	0	0	2,420	2,306	1,119
2002	0	29	435	1,035	245	142	28	16	10	2	1	0	0	1,942	1,913	1,478
2003	0	67	338	627	472	97	71	27	2	1	2	0	0	1,702	1,636	1,298
2004*	0	11	664	322	264	127	16	13	2	2	0			1,421	1,409	746

2004 landings for Jan. 1 to July 1.

Table 9a. Weights-at-age for cod in Division 4X.

		1	2	3	4	5	6	7	8	9	10	11	12
	1983		0.76	1.22	1.81	2.50	3.93	6.09	8.22	10.76	11.83	12.22	16.59
	1984		0.96	1.30	1.69	2.34	3.37	4.68	6.83	8.60	11.06	13.21	14.03
	1985		0.60	1.07	1.47	2.00	3.06	4.55	6.70	6.89	9.00	14.16	15.66
	1986		0.78	1.13	1.63	2.21	3.47	4.69	7.15	8.83	8.81	13.11	13.10
	1987		1.23	1.40	1.83	2.61	3.46	4.99	7.33	8.36	10.66	11.80	15.85
Scotian	1988		0.94	1.30	1.90	2.69	3.98	5.23	8.06	9.88	10.93	13.05	16.04
Shelf	1989	0.78	1.23	1.57	2.21	2.75	3.96	4.88	7.86	9.46	11.95	15.04	14.81
including	1990		0.82	1.29	1.97	2.86	3.72	5.59	8.10	10.46	11.93	14.12	15.24
4Xp	1991		0.76	1.13	1.73	2.50	3.54	5.08	6.44	9.44	11.19	13.73	15.74
	1992		0.78	1.14	1.63	2.58	3.58	4.44	6.50	8.37	12.10	14.50	19.15
	1993		0.68	1.25	1.62	2.24	3.44	4.67	7.01	9.13	10.97	18.08	
	1994		0.76	1.04	1.92	2.41	3.15	4.97	5.21	9.28	15.98	13.56	
	1995		0.86	1.23	1.72	3.26	4.09	4.69	7.23	9.18	13.33	16.33	
	1996		0.75	1.21	2.06	2.96	4.77	5.53	6.39	9.80	12.02	10.12	
	1997		1.17	1.22	1.83	3.31	4.49	6.04	8.83	9.99	11.14	13.58	8.71
	1998		0.86	1.12	1.71	2.54	4.42	4.72	7.33	9.76	9.66	10.83	16.17
	1999		1.00	1.71	2.32	2.83	4.03	5.43	8.26	10.70	13.24	11.35	16.54
	2000		0.93	1.50	2.32	2.85	3.14	4.05	5.57	4.33	6.74	10.25	12.53
	2001		0.99	1.62	2.19	3.65	4.11	5.12	6.62	8.19	8.72	11.05	0.00
	2002		0.75	1.29	2.39	3.08	4.55	5.70	7.24	7.32	8.54	7.61	
	2003		0.78	1.45	2.14	3.63	5.08	6.36	7.17	10.38	12.60	12.74	
	Mean	0.78	0.88	1.29	1.91	2.75	3.87	5.12	7.14	9.00	11.07	12.88	14.01
	1983	0.38	0.86	1.48	2.18	3.30	4.88	6.38	8.62	9.92	12.19	14.23	20.63
	1984	0.39	0.93	1.62	2.48	3.52	4.67	6.98	7.94	12.10	13.45	4.75	
	1985	0.37	0.84	1.48	2.26	3.43	4.53	6.54	9.45	11.46	15.12	18.23	19.52
	1986	0.37	0.80	1.41	2.33	4.30	6.24	7.36	8.18	9.50	14.25	7.99	11.98
	1987		0.84	1.57	2.56	4.17	5.33	7.04	7.92	7.94	14.31	18.56	
Bay of	1988		0.86	1.46	2.24	4.09	5.36	8.99	10.14	8.89	14.69		
Fundy	1989	0.33	0.76	1.52	2.59	3.60	6.33	7.25	10.32	10.55	14.57		11.66
	1990		1.05	1.69	2.69	3.77	4.37	7.31	8.15	11.32	11.95	12.75	14.74
	1991	0.82	1.04	1.88	2.91	4.26	6.77	8.75	11.02	13.60	14.17	15.10	17.93
	1992		1.18	1.73	2.73	4.49	6.51	8.78	9.93	13.13	14.55	11.10	
	1993		0.90	1.74	2.86	4.74	6.09	7.58	9.18	14.32	16.75	13.85	
	1994		0.98	1.75	3.19	5.72	7.96	9.31	11.61	11.56		17.46	
	1995		1.29	1.91	2.78	4.38	6.01	7.76	9.84	12.49	8.57	14.32	
	1996		1.06	1.70	2.85	4.71	6.12	5.97	10.56	11.05			13.19
	1997		1.17	1.73	2.74	4.28	5.77	8.44	10.30	9.18	12.94	11.07	22.55
	1998		1.16	1.99	3.14	4.49	5.91	8.13	9.20	12.75		14.32	
	1999	0.70	1.31	1.88	2.93	4.44	6.06	7.55	4.43			8.97	14.78
	2000		1.28	2.17	3.49	3.96	5.66	7.80	8.65	11.44	13.67	10.59	11.55
	2001		0.95	2.01	3.46	4.72	6.36	8.15	8.42	11.41	11.88		
	2002		1.33	2.15	3.51	5.27	7.04	8.14	10.13	12.03	18.09		
	2003		1.59	2.08	3.15	5.03	6.08	7.25	13.86	7.62		19.68	
	Mean	0.48	1.06	1.76	2.81	4.32	5.91	7.69	9.42	11.11	13.82	13.31	15.85

Table 9b. Weights-at-age for cod in Division 4X recalculated with deep water samples from 4Xp grouped with Fundy rather than Scotian Shelf

		1	2	3	4	5	6	7	8	9	10	11	12
Scotian Shelf	1993		0.67	1.21	1.66	2.28	3.44	4.49	6.61	9.67	11.08	17.30	
	1994		0.80	1.09	2.04	2.59	3.19	4.94	6.03	9.57	10.86	13.57	
	1995		0.85	1.23	1.87	3.45	4.13	4.82	7.58	9.92	13.35	16.39	
	1996		0.66	1.17	2.02	2.93	4.65	5.31	7.75	9.95	10.51	11.30	17.87
	1997		0.60	1.30	1.62	3.08	3.52	5.85	8.05	10.63	11.94	13.69	9.68
	1998		0.79	1.02	1.54	2.30	4.11	3.11	5.41	7.17	8.83		
	1999		0.80	1.72	2.16	2.87	3.78	5.03	8.29	12.23			
	2000		0.95	1.20	1.90	2.42	2.81	4.01	5.24	3.54		10.71	9.69
	2001		0.97	1.52	2.02	3.24	3.62	4.39	6.07	7.46	7.08	10.70	
	2002		0.76	1.19	2.00	2.60	3.99	4.73	6.32	6.11	7.34	6.49	
	2003		0.78	1.40	2.05	3.38	4.60	6.39	7.46	10.38	13.86	12.51	
	2004.5		0.62	0.99	1.56	2.99	3.77	3.69	7.64	12.69	9.80	13.64	
	Mean		0.77	1.25	1.87	2.84	3.80	4.73	6.87	9.11	10.47	12.63	12.41
Bay of Fundy	1993		0.92	1.73	2.74	4.32	5.70	7.39	9.25	13.45	15.99	14.75	
	1994		1.08	1.74	3.15	4.84	6.61	8.68	10.12	11.49	10.40	11.62	
	1995		1.05	1.77	2.84	4.49	5.87	8.18	9.75	12.15	10.17	14.32	
	1996		0.99	1.63	2.72	4.21	5.50	6.37	8.85	11.25	13.54	15.05	13.19
	1997		0.93	1.65	2.57	4.30	5.87	8.09	9.56	10.98	12.87	14.45	22.03
	1998		1.14	1.84	2.77	3.65	5.41	6.22	8.90	10.75	10.33	10.52	15.75
	1999	0.70	1.32	1.94	2.97	4.30	5.16	7.56	6.73	11.04	13.19	8.41	19.10
	2000		1.24	2.07	3.31	4.00	5.68	7.11	7.65	6.24	6.13	10.59	15.52
	2001		1.30	2.00	3.24	4.57	5.86	7.48	8.26	10.62	12.38		
	2002		1.33	2.02	3.43	4.29	5.64	6.67	9.25	9.29	11.95	10.59	
	2003		1.59	2.07	3.08	4.73	6.09	6.72	6.98	7.62	11.15	13.38	
	2004.5		0.80	1.64	2.71	4.19	5.58	8.42	8.52	7.31	8.80	14.35	
	Mean	0.70	1.14	1.84	2.96	4.32	5.75	7.41	8.65	10.18	11.41	12.55	17.12

Table 10a. RV survey stratified numbers for cod in 4X*.

age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1970	27	938	1528	2426	4217	1846	2546	1059	497	157	138	13	0
1971	21	363	7079	3934	676	1537	707	1054	119	0	17	0	0
1972	0	327	1424	3165	2537	712	502	202	538	376	164	22	182
1973	23	114	2197	1174	2141	626	253	155	33	170	63	29	26
1974	111	411	1004	4524	1126	1665	926	119	0	56	35	44	70
1975	0	1011	2864	1612	2950	2442	985	760	158	99	0	112	35
1976	0	152	1277	2812	2306	2051	888	375	220	67	69	13	26
1977	15	251	2281	4211	2541	789	1323	325	201	38	27	59	12
1978	23	183	1068	1712	2489	1345	496	362	93	71	0	0	0
1979	0	2728	3521	1814	1890	1764	1019	439	307	59	62	137	0
1980	2406	205	910	2864	1112	1052	1379	390	221	186	0	69	0
1981	62	2269	2366	2387	2496	1345	835	470	418	98	91	27	7
1982	73	750	1831	1828	1830	1481	876	243	260	186	49	31	41
1983	208	141	1085	4226	2369	1480	946	389	0	77	37	0	6
1984	0	820	5746	3390	2362	1820	688	482	63	58	25	0	0
1985	69	495	8760	4331	1527	1451	766	483	267	165	13	0	26
1986	25	768	1333	2920	1226	314	549	448	217	97	19	0	51
1987	6	392	2348	618	1180	528	260	245	304	75	40	63	0
1988	260	2630	3926	9246	1496	1548	496	210	244	91	38	13	0
1989	309	794	6089	3420	2549	420	489	108	27	82	37	14	0
1990	28	515	873	5523	2463	2321	240	414	80	42	0	21	27
1991	34	614	1727	1131	3086	1094	751	128	116	19	21	12	0
1992	35	252	2731	1569	681	1710	471	460	124	85	0	0	0
1993	14	369	955	2518	925	129	265	52	61	0	6	41	0
1994	748	1258	3313	2739	1605	449	36	195	88	70	0	32	65
1995	1212	122	847	4779	1477	598	274	94	91	34	42	7	0
1996	31	339	839	2048	5527	880	753	148	0	56	15	0	0
1997	95	349	569	1189	1444	2462	321	194	100	0	57	0	0
1998	65	211	1929	1808	1418	1022	1371	225	116	6	0	0	0
1999	869	382	787	1291	882	850	194	297	46	0	0	0	0
2000	3324	432	1497	830	999	409	325	157	148	0	0	0	21
2001	2170	150	1053	2891	951	646	44	60	0	31	0	0	0
2002	110	4329	1990	2573	2501	520	324	122	19	98	0	0	0
2003	715	499	3005	544	1102	745	189	78	20	19	0	0	0
2004	167	31	272	2977	319	324	113	27	8	0	0	0	0

*Survey vessel from 1970-1981 was A.T. Cameron, 1982 was Lady Hammond, 1983-2003 was Alfred Needler and 2004 was Teleost. No accepted conversion factors are available for vessel changes.

Table 10b. RV survey stratified numbers for cod in the Bay of Fundy*.

age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1970	0	547	243	323	579	219	489	184	75	19	70	0	0
1971	21	91	602	277	138	284	163	517	34	0	17	0	0
1972	0	316	473	633	1137	360	134	44	235	70	22	22	98
1973	23	51	826	207	885	217	132	71	0	127	31	0	0
1974	0	323	502	1329	650	407	433	19	0	56	35	38	70
1975	0	873	2303	756	365	648	392	201	113	27	0	112	27
1976	0	20	632	1006	463	854	574	245	171	67	33	0	20
1977	15	182	1344	2710	1725	268	779	192	34	0	27	59	0
1978	0	88	702	553	1441	797	379	296	67	71	0	0	0
1979	0	2623	2846	1563	790	947	677	177	59	34	0	72	0
1980	2406	205	702	1220	340	176	392	217	118	123	0	19	0
1981	0	920	1893	1478	1535	822	546	232	349	61	85	27	0
1982	24	518	1442	1380	1238	1085	629	221	238	94	0	31	27
1983	71	34	514	1069	456	543	400	244	0	63	37	0	0
1984	0	466	4328	2015	1161	313	150	66	63	23	25	0	0
1985	0	404	7923	3497	1184	995	283	169	190	165	0	0	20
1986	25	749	718	1974	717	163	114	99	21	97	0	0	0
1987	0	313	1118	313	855	278	154	177	117	49	40	63	0
1988	233	1837	2323	4103	179	661	268	103	187	0	0	0	0
1989	9	658	3179	1632	826	190	262	20	27	52	19	0	0
1990	0	364	660	3335	1044	1002	128	306	80	42	0	21	21
1991	0	466	620	532	1253	372	206	48	109	0	21	12	0
1992	0	144	2184	588	322	765	66	237	21	56	0	0	0
1993	0	336	659	1854	423	49	183	20	0	0	0	0	0
1994	657	878	2240	2113	996	180	16	143	38	20	0	32	32
1995	996	89	313	2671	418	351	45	47	60	0	42	0	0
1996	0	132	465	740	3149	578	324	0	0	32	0	0	0
1997	65	223	170	629	594	1236	194	85	0	0	31	0	0
1998	26	211	1488	1209	923	465	868	128	61	0	0	0	0
1999	192	313	457	561	207	115	29	199	46	0	0	0	0
2000	61	346	1346	585	734	179	102	12	0	0	0	0	0
2001	1262	0	567	1449	474	240	22	0	0	0	0	0	0
2002	0	4269	1743	2143	1954	214	183	73	19	73	0	0	0
2003	457	488	2771	334	875	601	174	49	20	19	0	0	0
2004	45	0	199	2497	127	119	79	0	0	0	0	0	0

*Survey vessel from 1970-1981 was A.T. Cameron, 1982 was Lady Hammond, 1983-2003 was Alfred Needler and 2004 was Teleost. No accepted conversion factors are available for vessel changes.

Table 10c. RV survey stratified numbers for cod on the Scotian Shelf in 4X*.

age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1970	27	390	1285	2103	3638	1627	2057	875	422	138	68	13	0
1971	0	272	6477	3657	538	1253	544	537	85	0	0	0	0
1972	0	11	950	2533	1400	352	368	158	302	305	142	0	84
1973	0	63	1371	967	1256	409	121	84	33	43	32	29	26
1974	111	88	502	3195	476	1258	493	100	0	0	0	6	0
1975	0	138	561	856	1585	1794	593	559	45	72	0	0	8
1976	0	132	644	1806	1843	1197	314	130	49	0	36	13	6
1977	0	70	937	1501	815	521	544	134	167	38	0	0	12
1978	23	95	365	1159	1048	548	117	66	26	0	0	0	0
1979	0	105	675	251	1099	817	342	262	248	26	62	65	0
1980	0	0	208	1644	772	876	987	173	103	63	0	51	0
1981	62	1349	473	909	961	523	290	238	68	37	6	0	7
1982	49	233	389	448	592	396	248	22	22	92	49	0	14
1983	136	107	571	3157	1914	937	546	146	0	13	0	0	6
1984	0	354	1417	1376	1201	1507	538	416	0	36	0	0	0
1985	69	90	837	834	343	456	483	314	77	0	13	0	6
1986	0	19	616	947	509	151	435	349	195	0	19	0	51
1987	6	79	1229	305	325	250	106	68	187	26	0	0	0
1988	27	793	1602	5143	1317	887	228	107	57	91	38	13	0
1989	301	136	2910	1789	1723	230	227	89	0	30	18	14	0
1990	28	151	213	2187	1419	1319	113	108	0	0	0	0	7
1991	34	147	1107	599	1833	722	545	80	7	19	0	0	0
1992	35	108	547	981	359	946	405	224	104	29	0	0	0
1993	14	33	296	664	502	80	82	32	61	0	6	41	0
1994	92	380	1073	626	610	268	19	51	50	50	0	0	33
1995	216	33	534	2107	1059	248	229	47	32	34	0	7	0
1996	31	207	374	1307	2378	303	429	148	0	24	15	0	0
1997	30	126	399	560	850	1225	128	109	100	0	26	0	0
1998	39	0	441	599	495	557	503	97	55	6	0	0	0
1999	677	69	330	730	675	736	165	98	0	0	0	0	0
2000	3263	86	151	246	265	230	223	144	148	0	0	0	21
2001	908	150	487	1441	477	406	22	60	0	31	0	0	0
2002	110	59	247	430	547	306	141	49	0	25	0	0	0
2003	258	11	234	210	227	144	15	30	0	0	0	0	0
2004	122	31	74	480	192	205	34	27	8	0	0	0	0

*Survey vessel from 1970-1981 was A.T. Cameron, 1982 was Lady Hammond, 1983-2003 was Alfred Needler and 2004 was Teleost. No accepted conversion factors are available for vessel changes.

Table 11. ITQ survey indices-at-age for cod in 4X, and by region within 4X

4X	0	1	2	3	4	5	6	7	8	9	10
1996	1	302	662	835	737	84	31	6	0	2	0
1997	1	225	232	727	393	265	17	24	6	2	1
1998	16	179	857	619	276	112	112	15	7	0	0
1999	8750	601	700	708	170	98	15	24	5	1	0
2000	5	1063	1039	351	234	62	61	15	13	0	0
2001	907	234	2369	3391	382	142	5	21	5	6	0
2002	37	380	551	510	343	63	35	21	2	4	0
2003	37	283	1099	551	322	167	36	12	4	1	0
2004	7	370	142	746	258	98	48	8	2	3	1

FUNDY	0	1	2	3	4	5	6	7	8	9
1996	1	259	487	359	427	61	13	1	0	1
1997	0	207	126	529	204	182	10	17	5	1
1998	16	150	754	493	186	40	69	4	1	0
1999	8748	506	412	526	92	50	8	22	5	0
2000	3	955	738	156	135	21	6	4	4	0
2001	907	115	2120	3196	298	83	2	5	0	0
2002	35	343	97	277	253	25	20	17	2	0
2003	36	278	771	133	213	137	32	9	2	0
2004	6	348	92	361	33	28	16	1	1	1

Shelf	0	1	2	3	4	5	6	7	8	9	10
1996	0	43	175	476	310	23	17	5	0	1	0
1997	1	18	106	198	189	83	7	7	1	1	1
1998	0	29	103	126	89	71	44	11	6	0	0
1999	2	95	287	182	78	48	7	2	0	1	0
2000	2	108	301	196	98	42	55	11	9	0	0
2001	0	119	249	195	84	59	3	16	5	6	0
2002	2	37	454	233	89	39	14	4	0	4	0
2003	1	5	328	418	109	30	3	3	2	1	0
2004	1	22	50	385	225	70	32	7	1	2	0

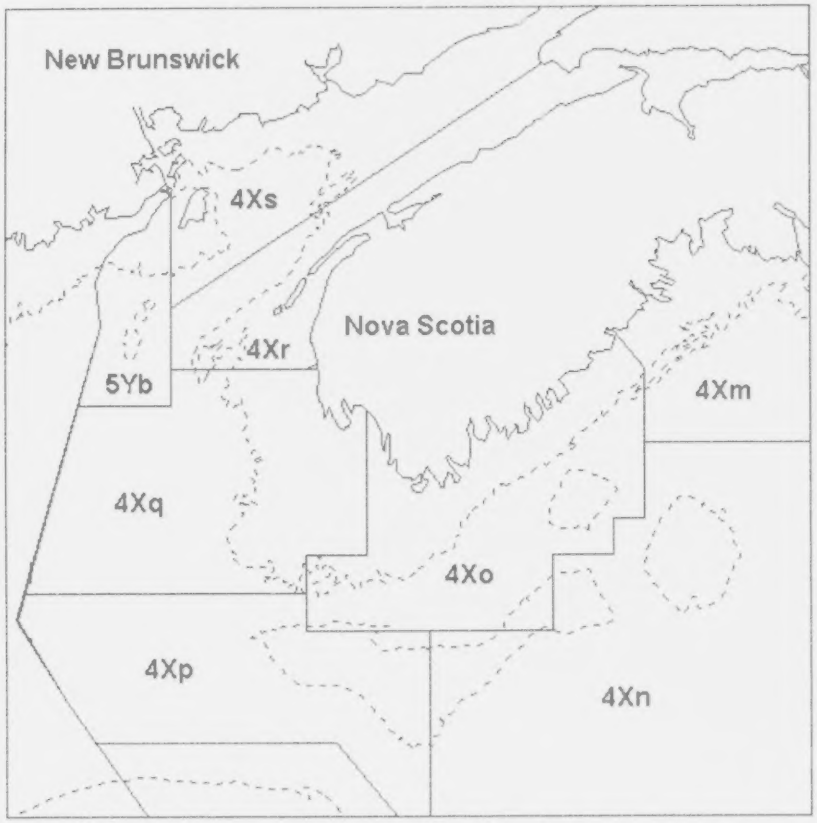

Figure 1. Canadian statistical unit areas in Division 4X.

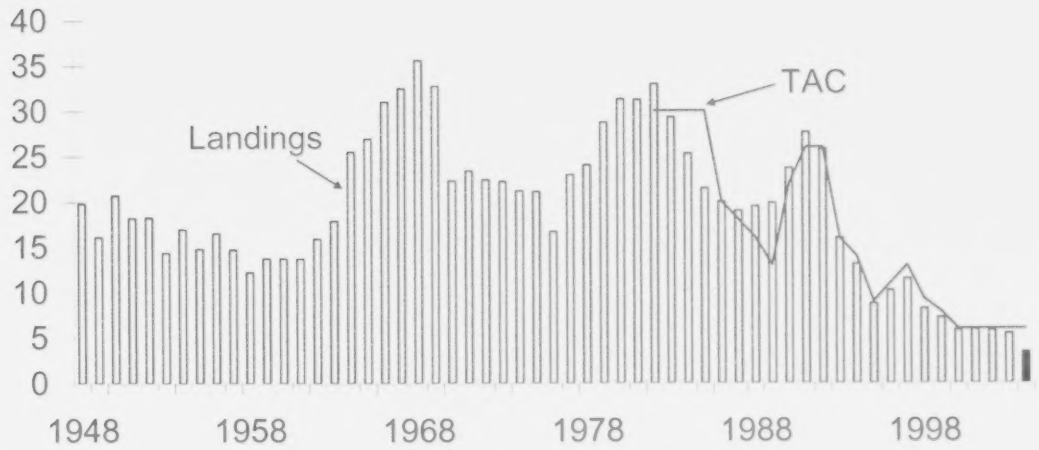

Figure 2. Nominal landings and quota (TAC) of cod in Division 4X and Canadian portion of 5Y by quota year (2004 landings for partial year).

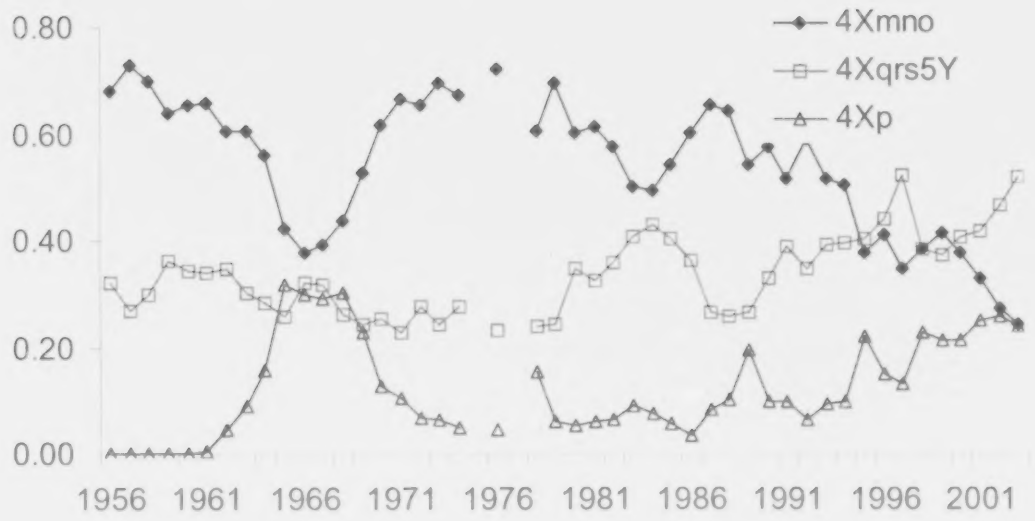

Figure 3. Proportion of cod landings by region in 4X.

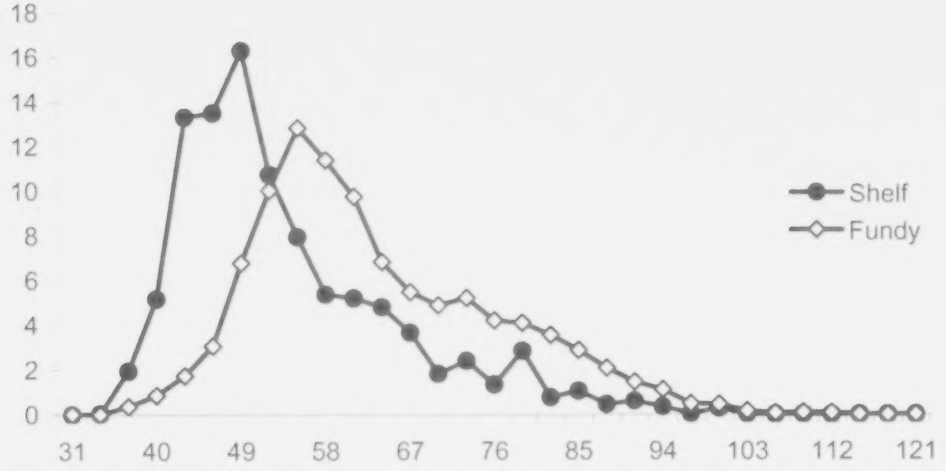

Figure 4. Proportion at length (cm) in commercial landings of 4X cod by area in 2003.

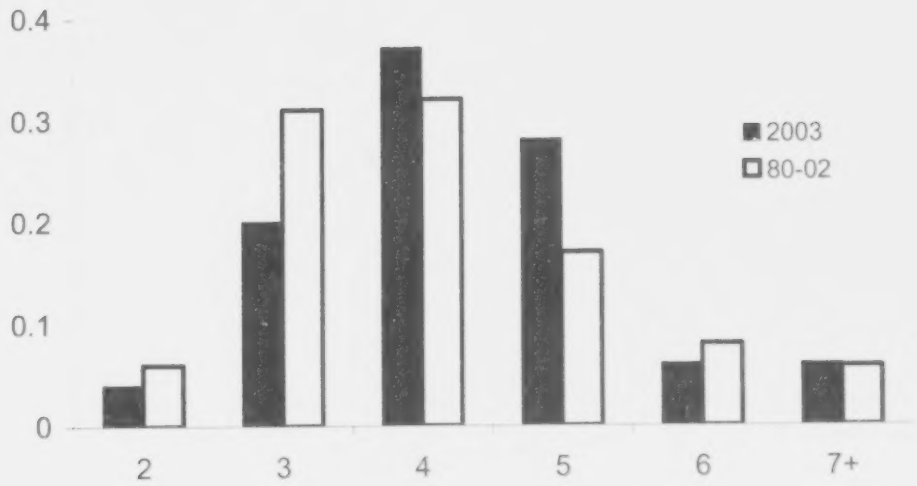

Figure 5. Proportional age composition for landings of 4X cod (numbers of fish) for 2003 compared to the average.

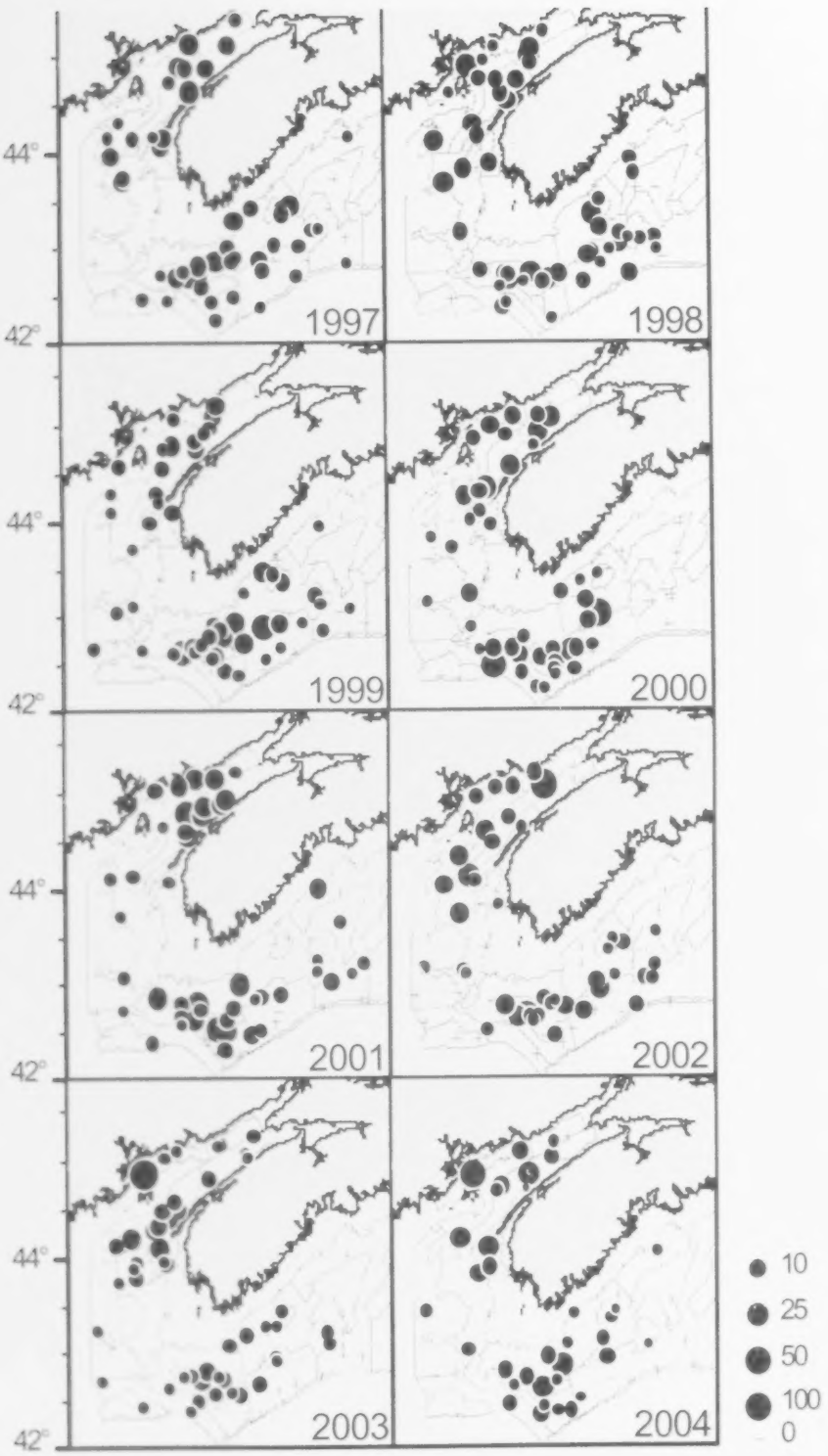

Figure 6. Distribution and magnitude of RV survey 4X cod catches (kg).

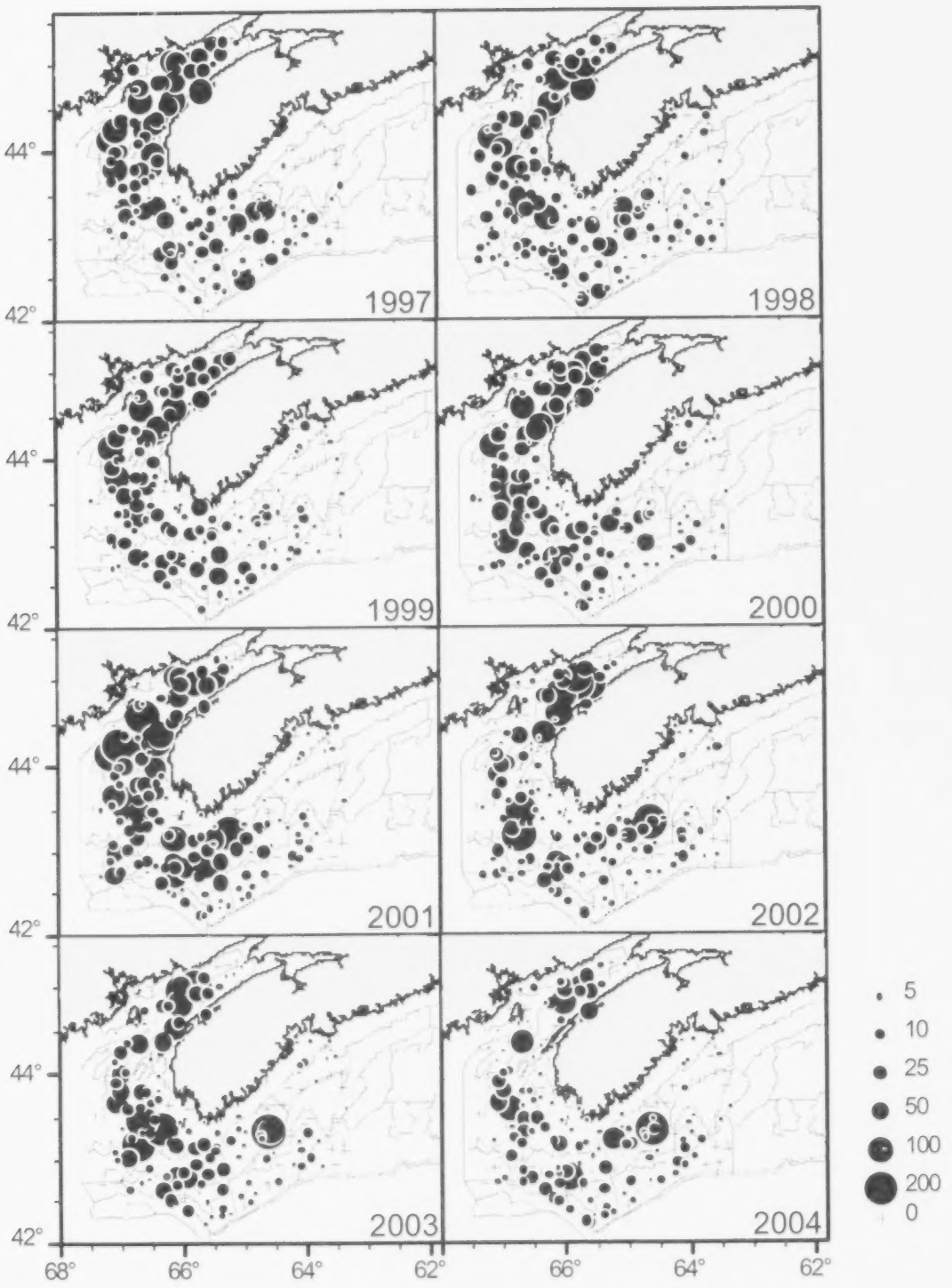

Figure 7. Distribution and magnitude of annual ITQ survey cod catches (kg).

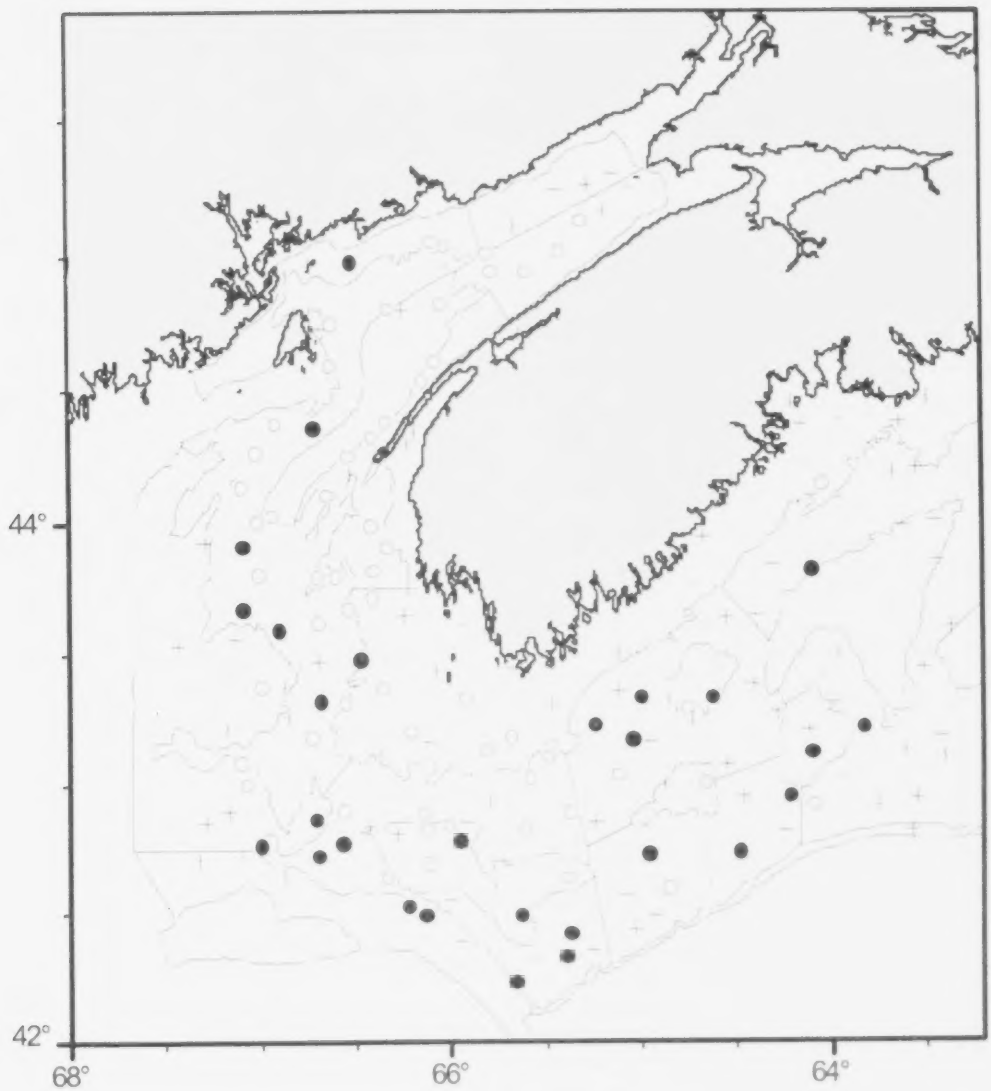

Figure 8. A comparison of ITQ survey cod catches for 2004 with the median value for each station since 1996. • 2004 value>median; + 2004 value is within 1 of the median; o 2004 value<median.

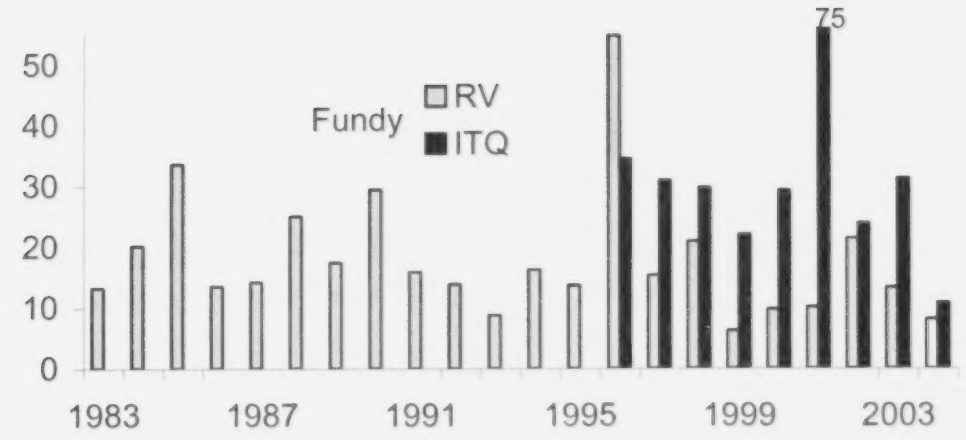

Figure 9. RV and ITQ survey biomass indices (kg/tow) for 4X cod in the Bay of Fundy (2004 RV survey data from Teleost).

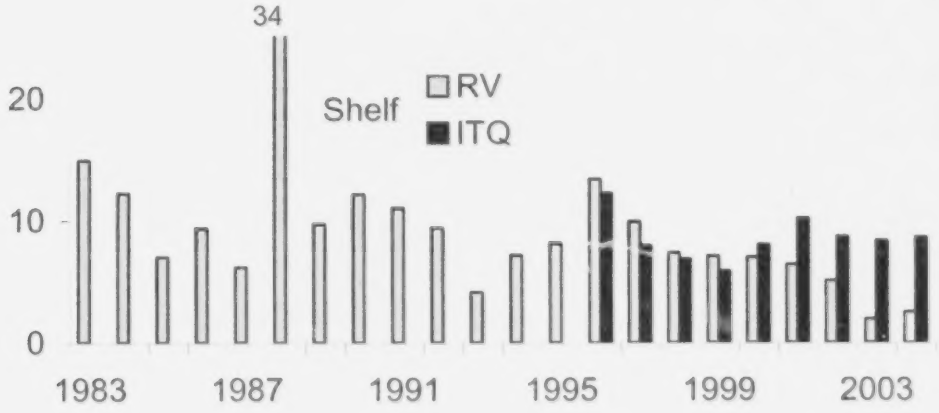

Figure 10. RV and ITQ survey biomass indices (kg/tow) for 4X cod on the Scotian Shelf (2004 RV survey data from Teleost).

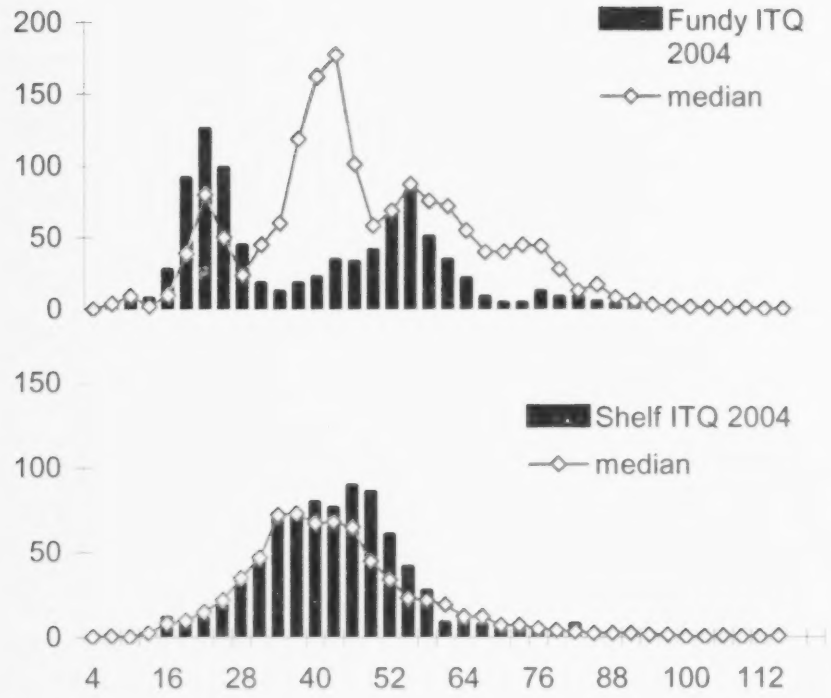

Figure 11. Length frequencies (cm) for 4X cod caught in the ITQ survey.

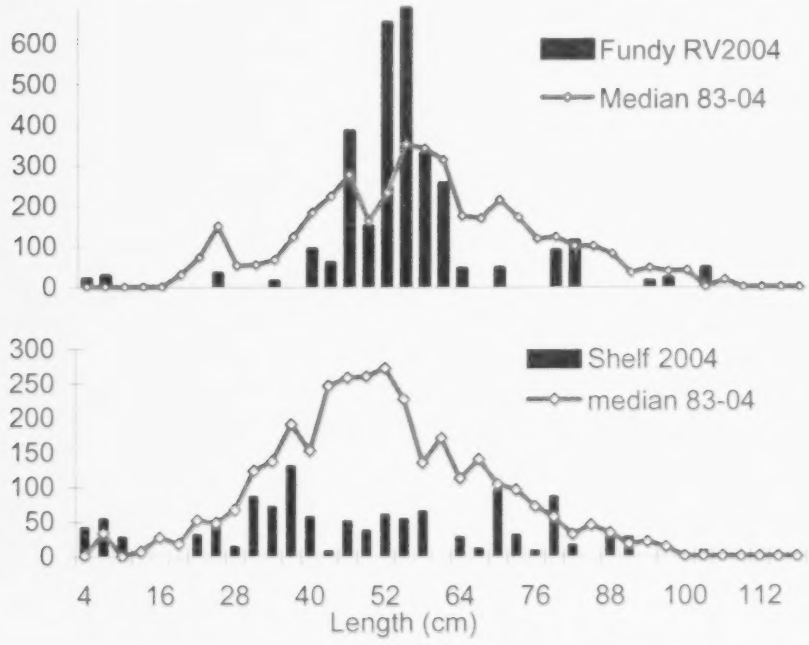

Figure 12. Length frequencies (cm) for 4X cod caught in the 2004 RV survey.

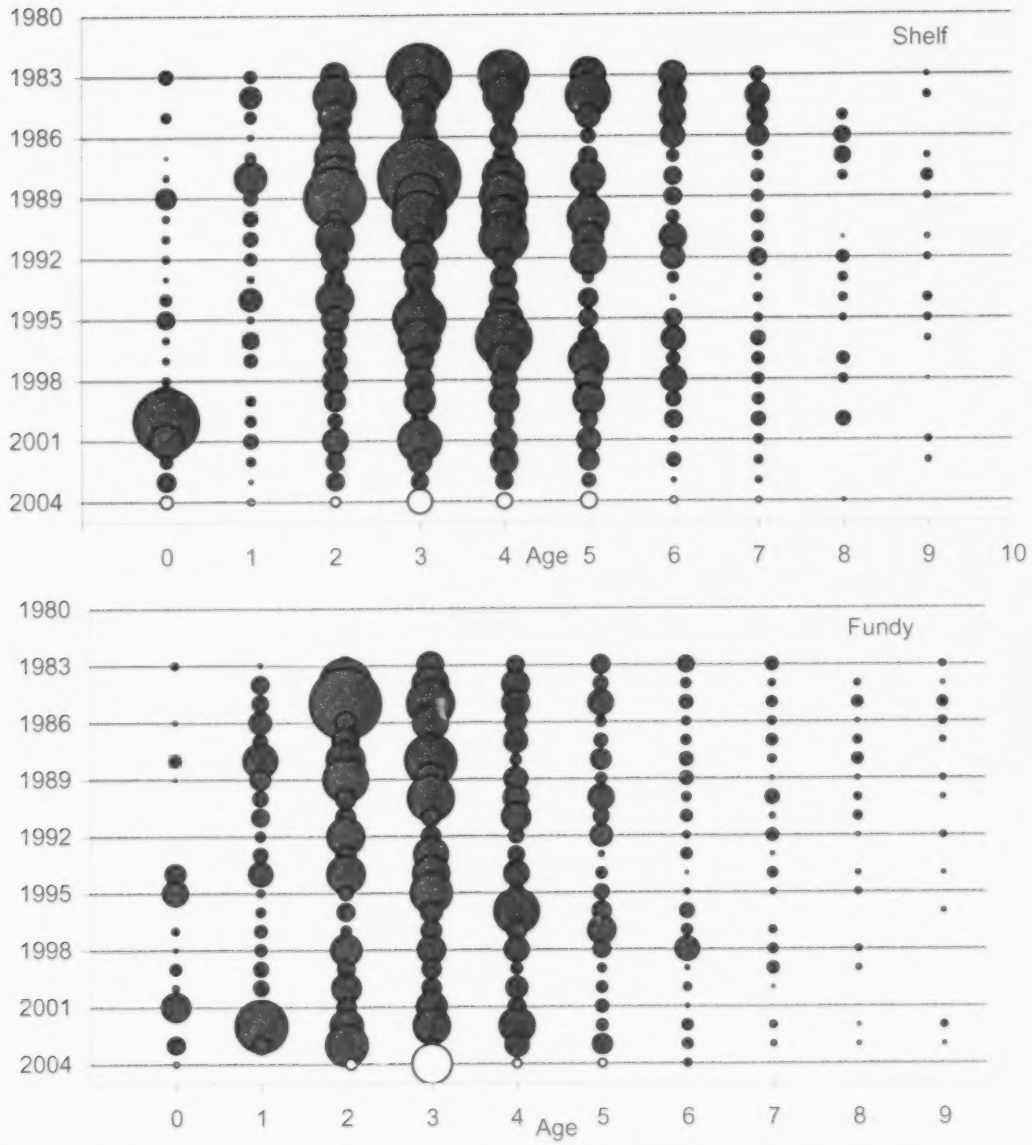

Figure 13. RV survey indices at age for 4X cod; 2004 indices from *Teleost* shown with open symbols (circle area proportional to abundance).

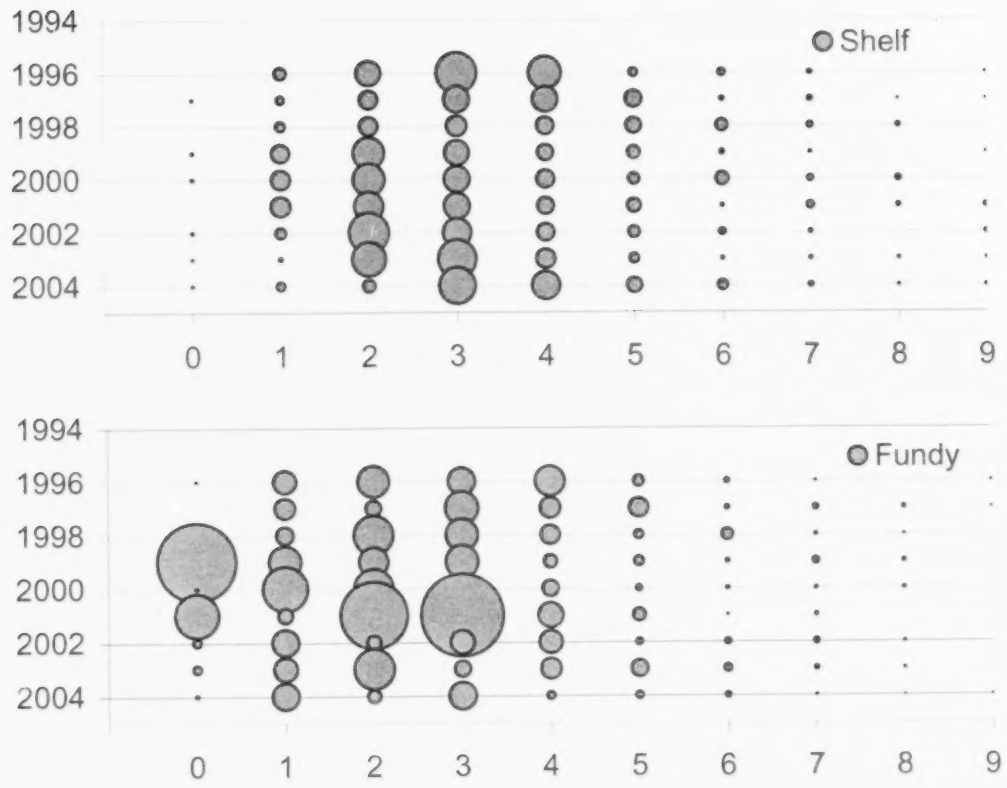

Figure 14. ITQ survey indices at age by area for 4X cod

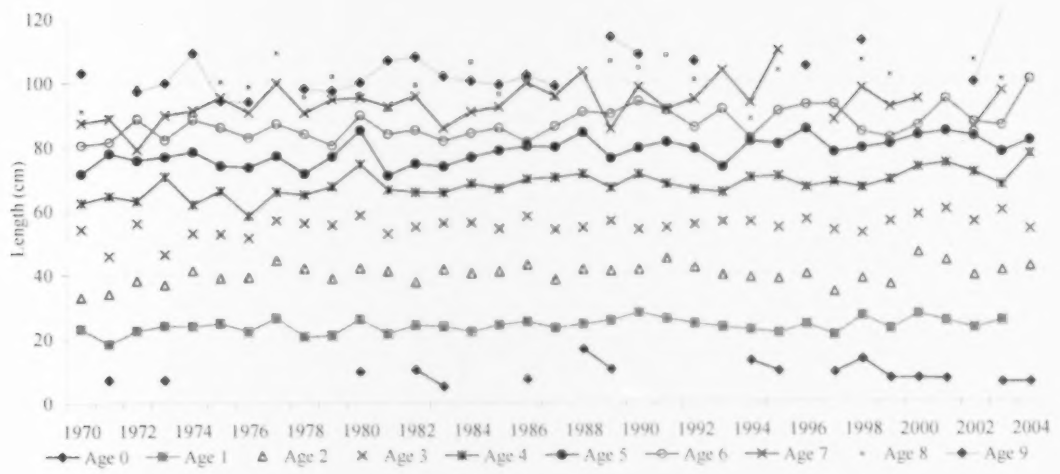

Figure 15a. Length at age in the Bay of Fundy from the RV survey.

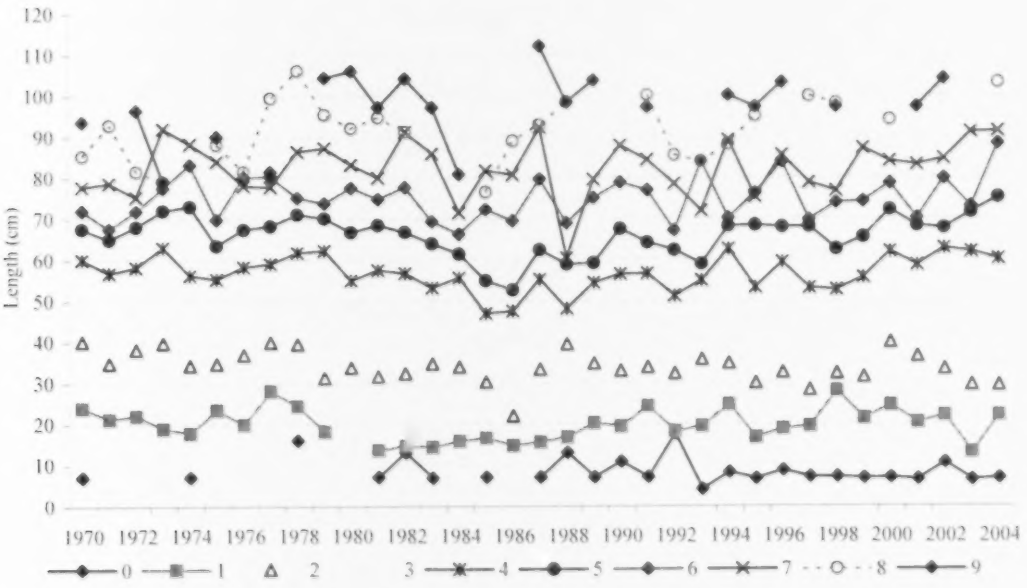

Figure 15b. Length at age on the Scotian Shelf from the RV survey.

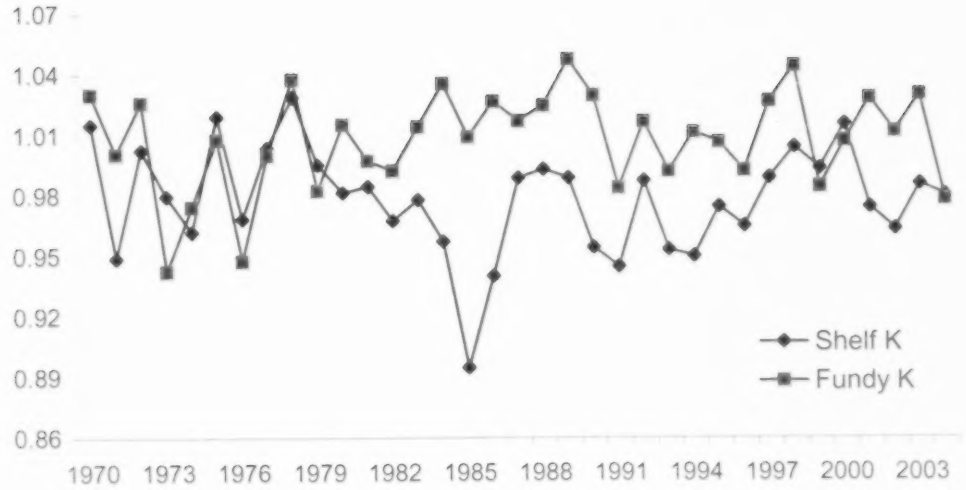

Figure 16. Condition factor (Fulton's K) for 4X cod from the RV survey.

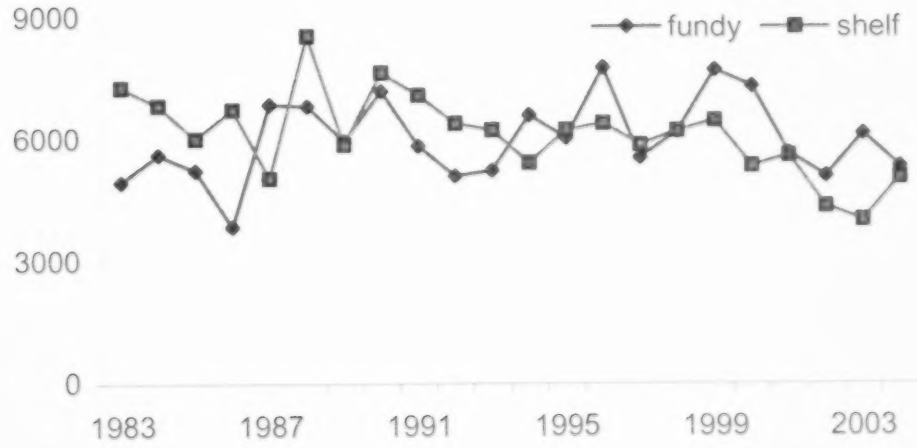

Figure 17. Area occupied by 4X cod from the RV survey.

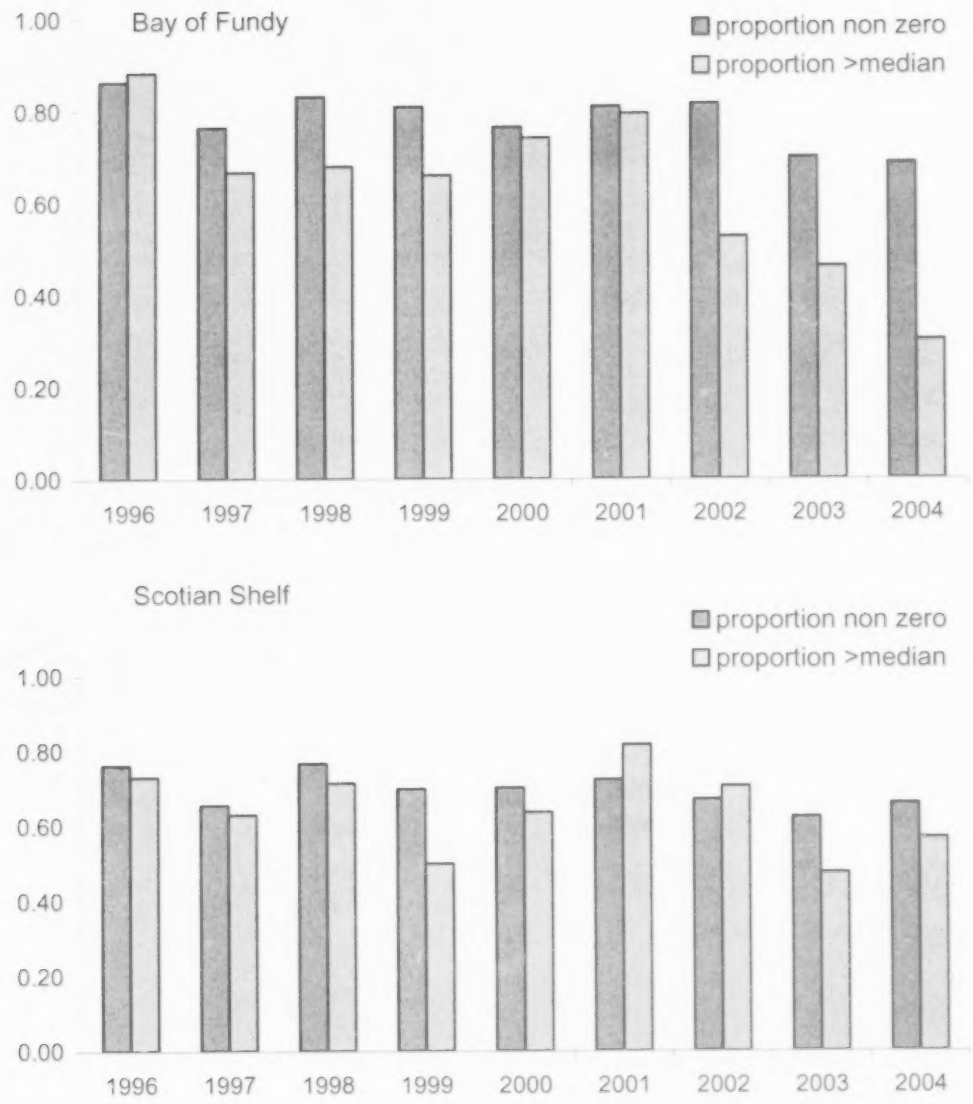

Figure 18. Proportion of ITQ survey fixed stations where cod were caught, and where catch was above the median for that location (1996-2004).

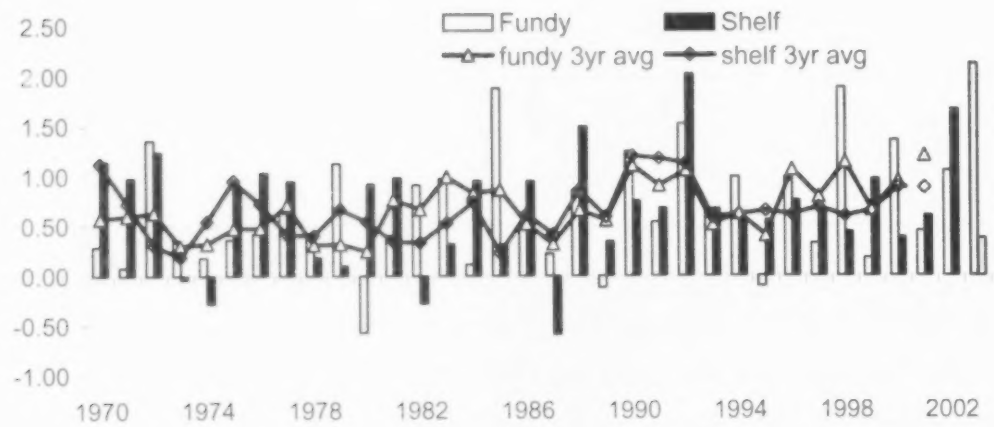

Figure 19. Total mortality estimates (Z) from the RV survey for 4X cod (final year includes data from the 2004 survey using the Teleost; 1981 value includes change from the Cameron using Yankee 36 trawl to Hammond using W IIa trawl, 1982 value includes vessel change from the Hammond to Needler).